NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

ANALYSING AMPHIBIOUS LOGISTICS CAPABILITIES IN THE JOINT THEATER LEVEL SIMULATION (JTLS)

by

Mark J. Cwick

September, 1996

Thesis Advisor: Sam Parry

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 1996	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. Analysing Amphibious Logistics Capabilities in the Joint Theater Level Simulation (JTLS)	5. FUNDING NUMBERS
6. AUTHOR(S) Cwick, Mark J.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION/AVAILABILITY STATEMENT	12b. DISTRIBUTION CODE
Approved for public release; distribution unlimited	

13. ABSTRACT (minimum 200 words)

One of the primary tools available to a Unified Commander-in-Chief (CINC) for training his staffs in execution of their joint plans is a command post exercise supported by a computer simulation. This is commonly referred to as a Computer Aided Exercise (CAX). The computer simulation used for this thesis is the Joint Theater Level Simulation. Currently, the after-action reviews (AARs) are mostly subjective in nature with very little quantitative analysis. The objective of this thesis is to develop a methodology for quantitatively evaluating the data produced by the computer simulation and presenting this analysis graphically. The methodology is based on the Universal Joint Task List which is a comprehensive listing of all joint tasks pertaining to the Armed Forces of the United States. These joint tasks provide the critical events that are analyzed during the CAX. The graphs display a causal audit trail for the critical events of the CAX. The focus of this thesis is Strategic Task Four, Theater Logistics, with specific analysis of amphibious logistics operations.

14. SUBJECT TERMS Amphibious Operations, Logistics, Universal Joint Task List, Joint Theater Level Simulation, Computer Aided Exercises, Measures of Effectiveness	15. NUMBER OF PAGES 75
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

Approved for public release; distribution is unlimited.

ANALYSING AMPHIBIOUS LOGISTICS CAPABILITIES IN THE JOINT THEATER LEVEL SIMULATION (JTLS)

Mark J. Cwick
Major, United States Marine Corps
B.S., United States Naval Academy, 1982

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
September 1996

Author: Mark J. Cwick

Approved by: Samuel H. Parry, Thesis Advisor

Lyn R. Whitaker, Second Reader

Frank Petho, Chairman
Department of Operations Research

ABSTRACT

One of the primary tools available to a Unified Commander-in-Chief (CINC) for training his staffs in execution of their joint plans is a command post exercise supported by a computer simulation. This is commonly referred to as a Computer Aided Exercise (CAX). The computer simulation used for this thesis is the Joint Theater Level Simulation. Currently, the after-action reviews (AARs) are mostly subjective in nature with very little quantitative analysis. The objective of this thesis is to develop a methodology for quantitatively evaluating the data produced by the computer simulation and presenting this analysis graphically. The methodology is based on the Universal Joint Task List which is a comprehensive listing of all joint tasks pertaining to the Armed Forces of the United States. These joint tasks provide the critical events that are analyzed during the CAX. The graphs display a causal audit trail for the critical events of the CAX. The focus of this thesis is on Strategic Task Four, Theater Logistics, with specific analysis of amphibious logistics operations.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

One of the primary tools available to a Unified Commander-in-Chief (CINC) for training his staffs in execution of their joint plans is a command post exercise supported by a computer simulation. This is commonly referred to as a Computer Aided Exercise (CAX). The computer simulation used for this thesis is the Joint Theater Level Simulation. Currently, the after-action reviews (AARs) are mostly subjective in nature with very little quantitative analysis. This thesis develops a methodology for quantitatively evaluating the data produced by the computer simulation and presenting this analysis graphically. The methodology is based on the Universal Joint Task List which is a comprehensive listing of all joint tasks pertaining to the Armed Forces of the United States. The UJTL provides a standardized tool for describing requirements in planning, conducting, assessing and evaluating the joint training. These joint tasks provide the critical events that are analyzed during the CAX.

The objective of this thesis is to develop an AAR for representing CINC staff performance in the execution of joint tasks during the conduct of a CAX. The focus of this thesis is on Strategic Task Four, Theater Logistics, during an amphibious operation as stated in the UJTL. Specific objectives are:

1. Develop the Measures of Effectiveness (MOEs) that summarize logistics information from an amphibious assault conducted during a CAX to provide insight into

the execution of logistics plans. This execution will be evaluated by extracting the planned, required and on-hand levels of water, fuel and ammunition throughout the CAX.

2. Develop an AAR based on graphical presentation of the MOEs gathered during a CAX.

Fundamental to this methodology is the assumption of vertical links between the levels of war and horizontal links within each level. An example of a vertical link is the relationship of the UJTL operational joint task "Provide Operational Support" (OP 4) to its respective strategic and tactical tasks "Sustain Theater Forces" (ST 4) and "Perform Combat Service Support" (TA 4). Within these levels of war there is also the vertical link between the respective joint, supporting and enabling tasks. A horizontal link is the relationship of UJTL joint tasks within a level of war. For example, how well "Synchronize Supply of Fuel in Theater of Operations" (OP 4.2) is performed will have an effect on "Provide Operational Mobility" (OP 1.3).

This thesis presents a methodology for analysing amphibious logistics capabilities by graphically displaying a causal audit trail of critical amphibious logistics events as they happened during a CAX. Because the data files are produced and sent to the postprocessor throughout the exercise, these graphs can be produced while the exercise is running for a quick analysis of the progress of the exercise. It is important to emphasize that this methodology is not intended to evaluate the performance of the joint staffs, but to display a causal audit trail for the critical events of the CAX. This causal audit trail provides insight into significant events that can be included in the AAR.

I. INTRODUCTION

The Chairman Joint Chiefs of Staff (CJCS) Memorandum of Policy 26 establishes a program for carrying out the joint training responsibilities of the Unified Commanders-in-Chief's (CINC's) component staffs. Memorandum of Policy 26 institutes a method for identifying training requirements through the review of the CINC's mission and the compilation of Joint Mission Essential Task List (JMETL). A CINC's JMETL is intended to provide the basis for all joint training.

The Universal Joint Task List (UJTL), CJCSM 3500.04, is a comprehensive listing of all joint tasks pertaining to the Armed Forces of the United States. It provides a standardized tool for describing requirements for the planning, conducting, assessing and evaluating of joint and multinational training. [Ref. 1] Specifically, tasks are defined as they relate to the strategic (national and theater), operational and tactical levels of war. Each joint task is broken down into *supporting* tasks which may in turn be further refined into *enabling* tasks.

One of the primary training tools available to a CINC for training his staff on their JMETLs is a command post exercise (CPX) supported by a computer simulation. This is commonly referred to as a Computer Aided Exercise (CAX). The primary role of the computer simulation is to present a decision environment within which the staff can be presented with realistic scenarios. Based on a stochastic environment, a staff can

implement plans, monitor the current situation, and further develop their plans while participating in this CAX.

A. PROBLEM STATEMENT

The objective of this thesis is to develop an after-action review (AAR) for representing CINC staff performance in the execution of joint tasks during the conduct of a CAX. For this thesis the CAX will be conducted using the Joint Theater Level Simulation (JTLS), focusing on Strategic Task Four, Theater Logistics, during an amphibious operation as stated in the UJTL. Specific objectives are:

1. Develop the Measures of Effectiveness (MOEs) that summarize logistics information from an amphibious assault conducted during a CAX, designed to be executed using JTLS, to provide insight into the execution of logistics plans. This execution will be evaluated by extracting the planned, required, and on-hand levels of water, fuel, and ammunition throughout the CAX.

2. Develop an AAR based on graphical presentation of the MOEs gathered during a CAX.

It is important to emphasize that this research is part of a larger ongoing research project which will attempt to provide an overall analysis methodology for all of the joint tasks specified in the UJTL within the context of a CAX. Concurrent with the development of the methodology presented in this thesis are similar efforts by Capt Kerry Gordon (USMC) [Ref. 2], CPT Kevin Brown (USA) [Ref. 3], CPT John Thurman (USA) [Ref. 4], LT John Mustin (USN) [Ref. 5] and LT Mark Sullivan (USN) [Ref. 6]. This

research also parallels previous efforts by LT Chris Towery, (USN) [Ref. 7] and CPT Ray Combs, (USA) [Ref. 8]. Since the performance of one joint task during a CAX often impacts the performance of another joint task, it is strongly recommended that the reader consider all papers in order to gain insight into an overall analysis methodology which attempts to identify common causal factors that influence significant events that occur during a CAX.

B. THESIS STRUCTURE

The next chapter provides an overview of the UJTL, amphibious logistics concepts and representation of logistics in JTLS. Chapter III describes the methodology for developing the logistics measures of effectiveness (MOEs). This chapter provides the details of the linkage across functional areas, critical logistics issues and the formulation of the MOEs. Chapter IV outlines the scenarios for the four JTLS runs, what was contained in the output files and how to create and analyze the graphs created for the AAR. The final chapter contains conclusions from this thesis and recommendations for further refinements and studies.

II. BACKGROUND

> The need for Joint Operations, Joint Thinking and Joint Leadership has never been greater...[we must] meet the global challenges and get the most out of our finite resources.
>
> Admiral William J. Crowe, Jr. [Ref. 9]

As the world's only super power, the United States needs a strong and capable military. In this age of draw downs and cutbacks, today's military must learn to train and operate in the joint arena. With lower force levels, there is less duplication of efforts among the military services. Therefore, each service's success is dependent upon the success of all the other services in this joint arena.

A. UNIVERSAL JOINT TASK LIST

The UJTL was developed by the Dynamic Research Corporation under the guidance of the Joint Exercise and Training Division of the J-7 Directorate. The UJTL gives, "a comprehensive hierarchical listing of the tasks that can be performed by a joint military force." [Ref. 1] This provides a common language for the joint forces in a tasks, conditions and standards format. This structure provides a system for planning, analyzing and evaluating joint operations.

The UJTL is organized into three levels of war as depicted in Figure 1, which also displays the joint tasks at each level of war. Within the UJTL is the joint tasks list, the linked conditions for the joint tasks and measures and standards for these tasks.

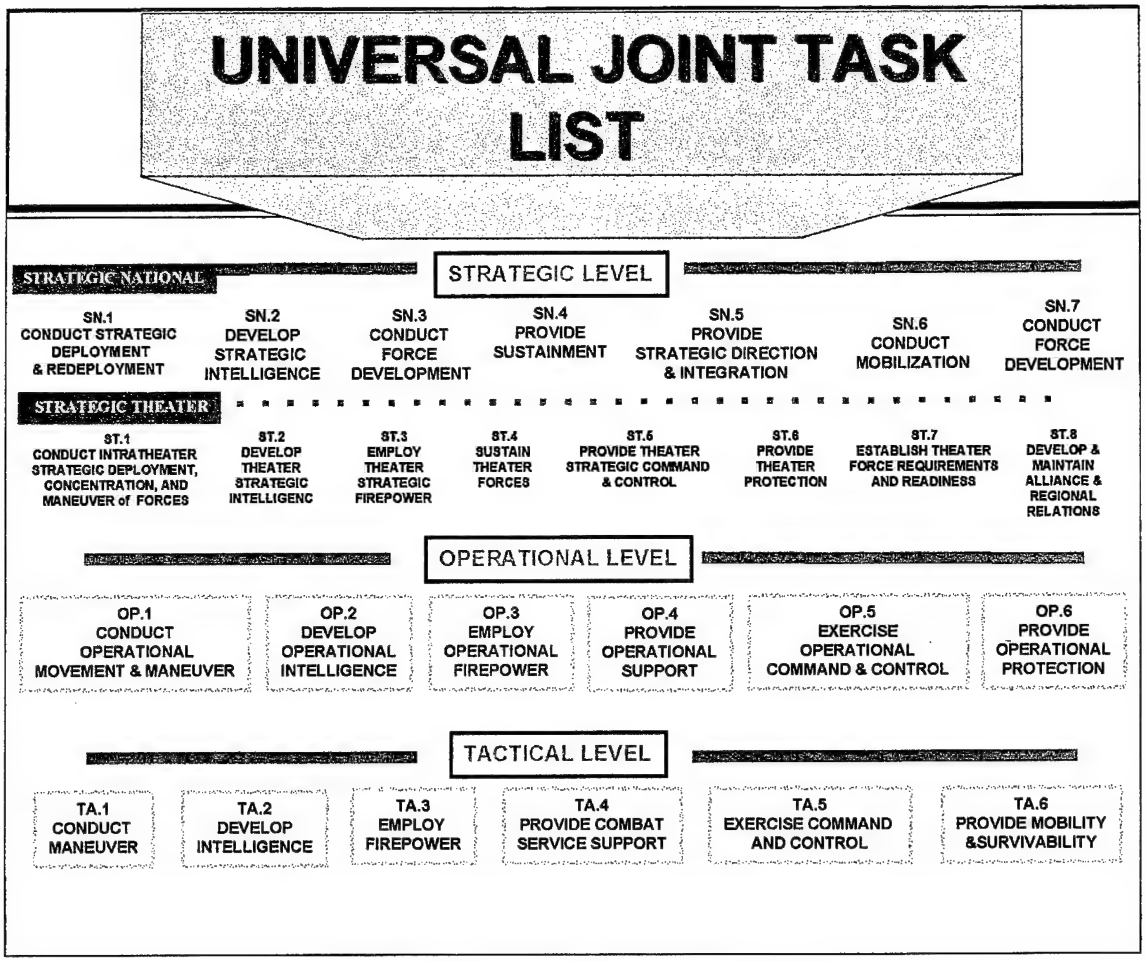

Figure 1. Universal Joint Task List.

The joint tasks are derived primarily from joint doctrine and joint tactics, techniques and procedures. The tasks are further refined into supporting, enabling and refined enabling tasks. The linked conditions are organized into three categories: physical, military and civil. The measures and standards provide performance criteria to assist joint commanders in assessing their forces' capabilities and more importantly their weaknesses. By knowing these capabilities and weaknesses the commander will be able to use his training time more effectively.

B. JOINT MISSION ESSENTIAL TASK LIST

The UJTL provides the basis for the development of a command's JMETL. The command's staff will analyze all their assigned missions and will select the appropriate joint tasks for their forces. Because the UJTL is structured by tasks, conditions and standards, the JMETL can be used to "develop a joint exercise program, develop a training and readiness assessment system, evaluate joint doctrine or provide links to operational plans." [Ref. 10]

C. JOINT TRAINING SYSTEM

> Because we operate and fight jointly, we must all learn and practice joint doctrine, tactics, techniques, and procedures... This is critical for our present and future effectiveness. *Joint doctrine offers a common perspective from which to plan and operate, and fundamentally shapes the way we think about and train for war.* [Ref. 11]

The JMETL is an integral part of the Joint Training System. The JMETL identifies the Commander-in-Chief's (CINC's) priorities and provides the basis for all joint training within his command. The Joint Training System, shown in Figure 2, is designed to ensure the preparedness of US forces to execute all assigned missions. The Joint Training System is made up of two processes which are indicated by the two ovals in Figure 2. The inner oval depicts the development of the CINC's JMETLs and the outer oval depicts the use of the JMETLs to develop and manage a joint exercise and training program. This Joint Training System is clearly focused on the efficient use of all training periods and ensures that the armed forces are properly trained. [Ref. 1]

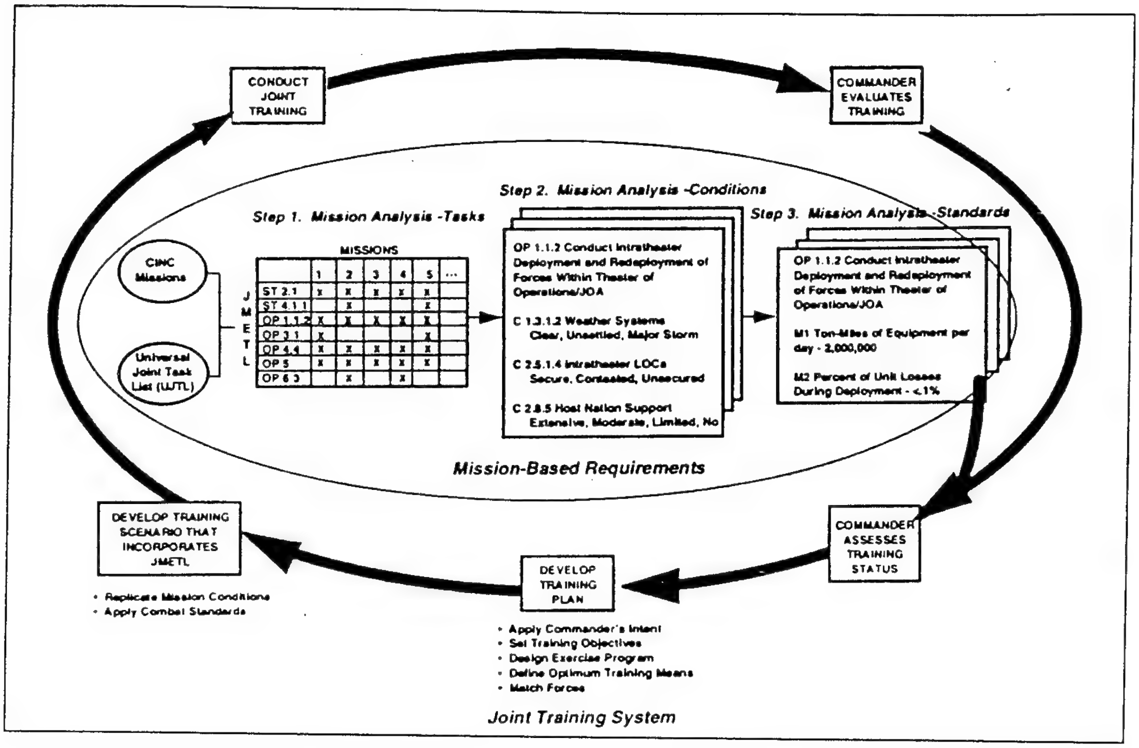

Figure 2. Joint Training System.

D. JOINT THEATER LEVEL SIMULATION

The Joint Theater Level Simulation is an interactive, multi-sided, joint and combined constructive simulation model. Because JTLS strives to model conflict at the operational level with tactical fidelity, it is an excellent model for CINCs' staffs to exercise their operation plans (OPLANs) in a joint environment without deploying forces. The Joint Theater Level Simulation supports explicit coalition warfare functions: dynamic coalition development, designation of political or military factions, setting rules of engagement, executing Host-Nation Support agreements and conducting Noncombatant Evacuation Operations. A modularized software architecture allows distributed operations across multiple hardware platforms. [Ref. 12]

The latest version of JTLS is release 2.0. This version has been used by the Joint Warfighting Center as the exercise model for Internal Look 96, Cobra Gold 96, Tempo Brave 96 and Ultimate Resolve 96. This version was also used during the scenario runs for this thesis.

E. AMPHIBIOUS LOGISTICS OPERATIONS

> Logistics provides the foundation of our combat power. It can be described as the bridge connecting a nation's economy to a nation's warfighting forces...A nation's capability to deliver logistic resources has historically been a major limiting factor in military operations. [Ref. 13]

An amphibious operation is an attack launched from the sea by naval and land forces on a hostile or potentially hostile shore. An amphibious task force (ATF) is assigned an amphibious operation area (AOA). For sustainment of the assault forces ashore, the combat service support element (CSSE) of the ATF will create beach support areas and helicopter landing zones throughout the AOA. From these support areas the CSSE will be organized to maintain an appropriate storage area to allow the continuous flow of supplies from the ships to the assault forces. This build-up must be flexible enough to allow for sudden changes in the tactical situation such as the need for a quicker advance of the assault forces or a hasty withdraw of the assault forces. The size of this build-up is also a factor of the size of forces ashore and the anticipated length of the operation.

The Marine Corps is structured around Marine Air-Ground Task Forces (MAGTFs) that "provide the joint force commander with a readily available,

self-sustaining, combined arms force capable of operating as the landing force of an amphibious task force." [Ref. 14] All MAGTFs are expeditionary in nature and are composed of four elements: the Command Element (CE), the Ground Combat Element (GCE), the Aviation Combat Element (ACE) and the Combat Service Support Element (CSSE). The two types of standing expeditionary forces in the Marine Corps are the Marine Expeditionary Force (MEF) and the Marine Expeditionary Unit (MEU). The main difference between these two forces is their size. The MEFs range in size from less than one to multiple infantry divisions and aircraft wings, together with force service support groups (FSSGs) while MEUs are composed of a reinforced infantry battalion, a helicopter squadron reinforced with fixed wing AV-8B aircraft and a MEU service support group (MSSG). The sustainment capabilities of the MEFs and the MEUs are 30 and 15 days, respectively.

Currently, the Marine Corps has two MEUs forward deployed to the Pacific and Mediterranean at all times. There is also a MEU permanently station on Okinawa. These forces are the lead elements for an amphibious assault. If time permits, the appropriate MEF would deploy a MEF (Forward) to the area as the lead echelon, either by air or by naval shipping or by a combination of air and naval shipping. This MEF (Forward) is normally composed of a reinforced infantry regiment, a Marine aircraft group and a brigade service support group (BSSG). The rest of the MEF would be brought into the AOA as follow-on forces as time permits. Since these forces come into the AOA being self sustaining for 15 or 30 days, the Marine Corps has time to decide how to build a

sustainment plan to support these forces if they are to operate longer than 15 or 30 days. In Desert Shield/Desert Storm the movement of 2nd FSSG to Al Khanjar is an excellent example of this. When the OPLAN for Desert Storm was proposed to General Krulak, Commanding General of the 2nd FSSG, he knew he could not support the plan from where he was. Therefore, in 14 days he moved the 2nd FSSG from Kibrit to Al Khanjar, approximately 150 km northwest and only 9 miles west of the Kuwait border. They were in place on 20 February 1991, four days before the ground war of Desert Storm began. They had a 780 acre ammunition dump, 5,000,000 gallon fuel farm and 1,000,000 gallons of water stored there. [Ref. 15]

The next chapter will present the methodology for evaluating specific logistic joint tasks that are in the UJTL.

III. METHODOLOGY

This chapter contains the methodology for developing MOEs that summarize logistics information in terms of the appropriate Universal Joint Tasks. Fundamental to the methodology is the assumption of vertical links between the levels of war and horizontal links within each level, as shown in Figure 3. An example of a vertical link is

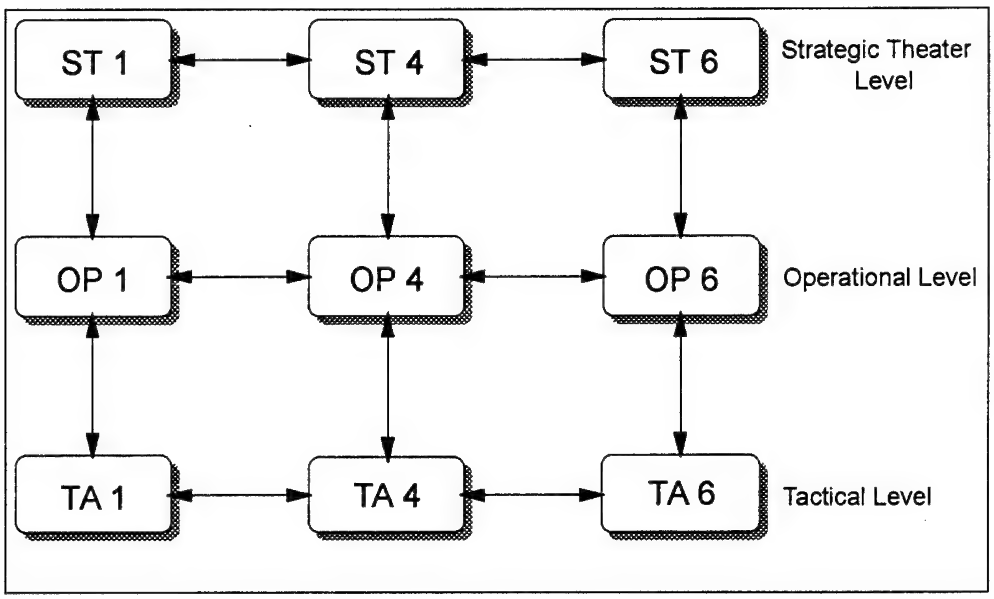

Figure 3. Vertical and Horizontal Links.

the relationship of the UJTL operational joint task "Provide Operational Support" (OP 4) to its respective strategic and tactical tasks "Sustain Theater Forces" (ST 4) and "Perform Combat Service Support" (TA 4). Within these levels of war there is also the vertical link between the respective joint, supporting and enabling tasks to be discussed later. A horizontal link is the relationship of UJTL joint tasks within a level of war. For example, how well "Synchronize Supply of Fuel in Theater of Operations" (OP 4.2) is performed

will have an effect on "Provide Operational Mobility" (OP 1.3).

A. CRITICAL LOGISTICS ISSUES

Brigadier General Brabham, commander of the 1st Force Service Support Group during Operations Desert Shield and Desert Storm, stated the following:

> Had there been an amphibious assault, the real logistical drivers would have been...ammo, fuel, and water...Now if you add the demands of decontamination of Marines and equipment...water-not ammunition-would have become the primary driver of the logistical effort. [Ref. 16]

The master dendritic diagram in Figure 4 displays the critical logistics issues consistent

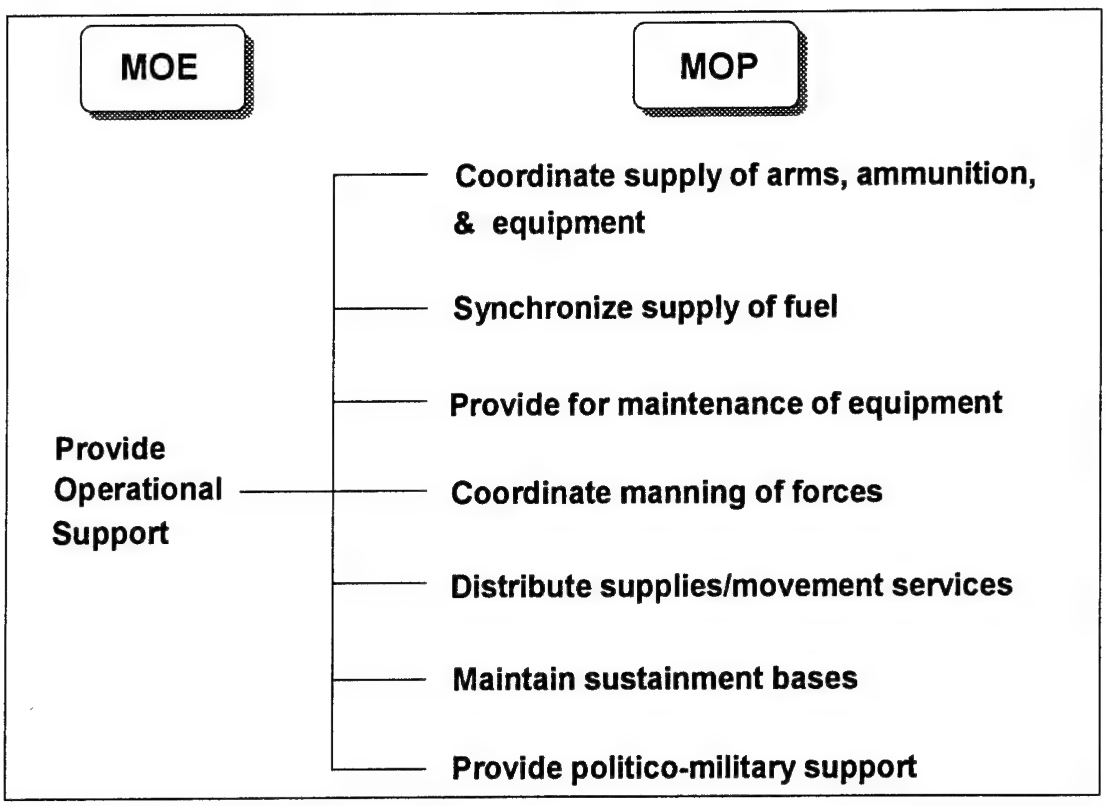

Figure 4. Master Dendritic Diagram.

with the UJTL at the Operational Level. The joint tasks from the UJTL provide the MOEs and the supporting tasks provide the measures of performance (MOPs). These

critical issues will be used to create the audit trail necessary to graphically display critical events that take place during a CAX. A critical event is *any* event occurring during a CAX that is useful in reconstructing how the CAX progressed. This thesis will graphically display the critical events that take place for on-hand water, fuel and ammunition to be used later in the AAR.

B. FORMULATION OF MOPs

The MOPs for this thesis from the UJTL are "Coordinate supply of arms, ammunition and equipment" (OP 4.1), "Synchronize supply of fuel" (OP 4.2) and "Coordinate manning of forces" (OP 4.4). For OP 4.1, OP 4.2 and OP 4.4, ammunition, (Class V), ground forces' fuel (Class IIIW) and water (Class I) are the specific supplies measured for the MOPs, respectively. These three MOPs are then categorized as either dry or wet supplies. Within these two categories, supplies are stored and distributed in the same manner, thus the calculation of the MOPs are the same for both categories. The equations used in this section are modifications of the equations developed by CPT Combs in his 1995 thesis [Ref. 8]. Definitions of the terms used in the development of the MOPs are given in Table 1.

A potential MOP for a tactical or a support unit is the percentage of force j's requirements on-hand at time t, for ammunition of type i, calculated as:

$$\frac{OH_{i,j}(t)}{REQ_{i,j}(t)}. \qquad (1)$$

Term	Definition
OH	on-hand amount
REQ	required
STORED	amount of stored supplies in supply units
TACREQ	sum of amount of supplies required by supported tactical units
OPREQ	total requirement of supplies of all units
MOBCAP	mobile capacity
STATCAP	static capacity
util	utilized
i	resource type
j	tactical unit

Table 1. MOP Terms.

Another possible MOP for a support unit is the percentage of force j's future requirement at time t', that is currently on-hand at time t, for ammunition of type i, calculated as:

$$\frac{STORED_{i,j}(t)\text{-}TACREQ_{i,j}(t)}{OPREQ_{i,j}(t')}. \tag{2}$$

For amphibious operations the capability to store large amounts of supplies is with the FSSG for the MEF and the MSSG for the MEU. The tactical units have very limited storage capabilities in an amphibious operation and for this thesis they will carry two days of dry supplies.

The partial dendritic diagram displayed in Figure 5 shows how MOPs for OP 4.1 can be further refined for analysis. In this thesis the graphical displays shown later have the planned support levels and the actual support levels plotted together.

The MOP for a given type of fuel or water i, is the percentage of force j's

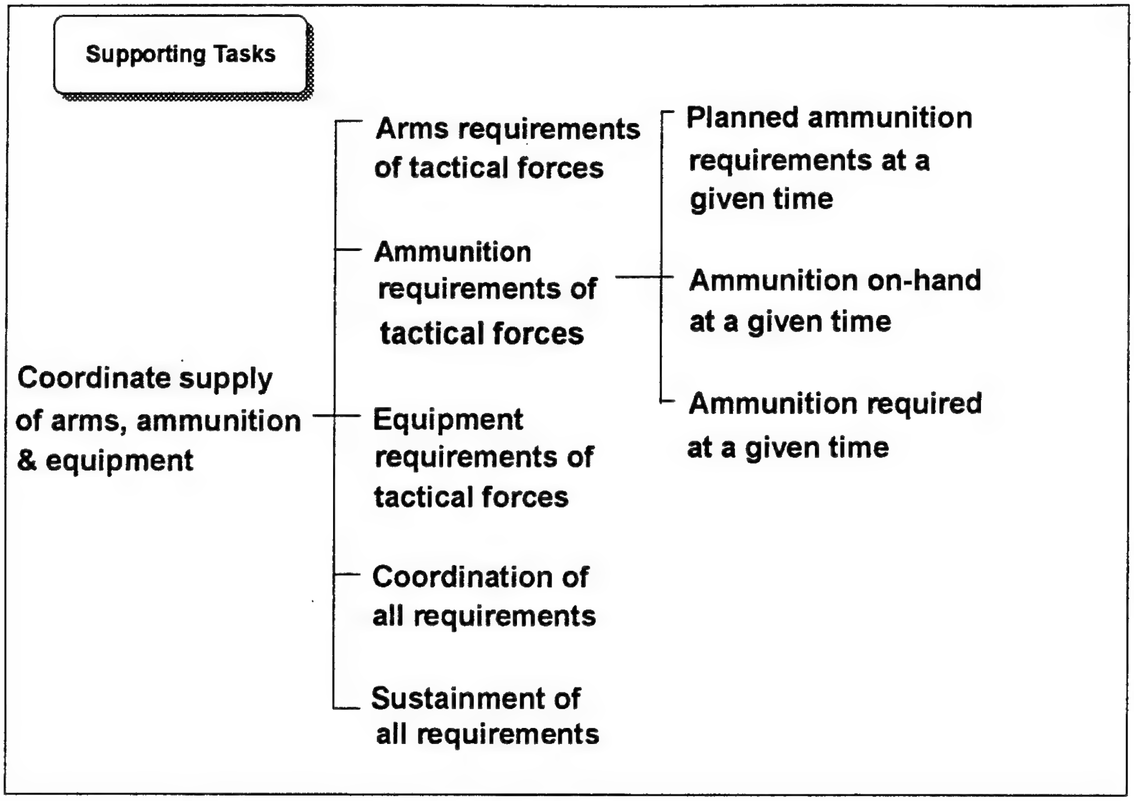

Figure 5. Partial Dendritic Diagram For Ammunition.

requirements that are on-hand at time t, given by:

$$\frac{OH_{i,j}(t)}{REQ_{i,j}(t)}, \tag{3}$$

where

$$OH_{i,j}(t) = MOBCAP_{i,j}^{util}(t) + STATCAP_{i,j}^{util}(t). \tag{4}$$

For wet storage, an actual MEU has two 4500 gallon fuel trucks, one 2700 gallon water truck, four 400 gallon waterbulls and thirty six 500 gallon bladders [Ref. 17]. The partial dendritic diagrams for fuel and water are in Appendix A.

C. JTLS LOGISTICS FUNCTIONS

> At the operational level much more than at the tactical, logistics may determine what is possible and what is not; for "a campaign plan that cannot be logistically supported is not a plan at all, but simply an expression of fanciful wishes."
>
> John F. Meehan III [Ref. 18]

This section gives a summary of the details contained in Chapter 6 of the JTLS Analyst Guide. [Ref. 19] In JTLS, each unit is described by a Tactical Unit Prototype (TUP) and a Sustainment Logistics Prototype (SLP). The TUP contains information about the unit's strength (personnel and equipment), average movement rate, capabilities to carry and store supplies (dry and wet), combat systems scores and consumption rates for supply categories. The SLP contains information about classes of cargo and tanker trucks and the reserved fraction a unit holds for its own use of each supply category. Units that have similar Table of Equipment (TOE) share TUPs and SLPs. The supply unit and the supported unit must have the same SLP.

In the data base used for this thesis there were no existing TUPs for MEUs or MSSGs, therefore they had to be created. The basis for the information in the TUPs was to begin with a TUP from a similar sized unit already in the data base and then modify only the areas that would be considered. The areas that were modified included capacity to store and carry supplies (dry and wet), combat system's TOE, and supply categories CL.I.W, CL.III.W and CL.V. To develop the TUPs for the MEUs and the MSSGs specifically, Capt Nickel, USMC, an instructor at the Combat Service Support Branch of

the Expeditionary Warfare Training Group , Atlantic, was contacted. He provided a *generic* MEU Force List and TOE. An area that was not modified was the TUP combat systems scores. Each combat system is categorized into one of 84 prototypes, each having an associated TUP combat system score. The worth of a unit in JTLS is calculated by summing up the values of the these scores for those combat systems that a unit has. These scores can be found in Appendix B. With all the above information the following TUPs were created: Tactical Unit Prototype AMPHIB.BN.1 (Type 69) for the MEUs and Tactical Unit Prototype MSSG.1 (Type 40) for the MSSGs. Type 69 included information about the MEU Command Element and the Ground Combat Element and Type 40 included information about the Combat Service Support Element (CSSE). A description of these TUPs can be found in Appendix B.

The TUPs that were in the original data base also did not include any information on water (CL.I.W). The data for water that were added to these TUPs came from FM 101-10-1, an Army publication, and are shown in Table 2. The unit of measure in all cases is gallons per man per day. For this thesis a value of 5.39 gallons per man per day was calculated using the hot climate values from Table 2 for drinking requirements (3.0), heat treatment (0.2) and personal hygiene (1.7) for a total of 4.9 and adding 10% of that for waste (0.49).

The Sustainment Logistics Prototype for this thesis was not modified and a copy of it is in Appendix C.

Uses	Climate		
	Hot	**Temperate**	**Cold**
Drinking Requirements	3	1.5	2
Heat Treatment	0.2	0	0
Personal Hygiene	1.7	1.7	1.7
Centralized Hygiene	1	1	1
Food Preparation	0.0-4.5	0.0-4.5	0.0-4.5
Laundry	2.1	2.1	2.1
Divisional Medical Treatment	0.4	0.4	0.4
Waste (10%)	0.8-1.3	0.7-1.1	0.7-1.2

Table 2. Recommended Water Consumption Planning Factors (gals/man/day).

D. PLANNING FACTORS

In order to build a plan for comparison of the actual results, a total daily consumption had to be determined for each class of supplies. Since JTLS is a theater level model, updates of every six hours were chosen to calculated consumption.

For the MEU, the following calculation determines water consumption rates:

1470 x 5.39 = 7923.3 gals per day or 1981 gals every 6 hrs.

For the MSSG, the following calculation determines water consumption rates:

283 x 5.39 = 1525.37 gals per day or 381 gals every 6 hrs.

In JTLS fuel is also measured in gallons per man per day. Since it is not normally planned this way for a MEU, the planning figure of 2.8 gals per person per day given in the data base is used. Therefore, the fuel consumption for the MEU is:

1470 x 2.8 = 4116 gals per day or 1029 gals every 6 hrs.

It is recommended that fuel consumption be changed in JTLS to gallons per vehicle per day to reflect realistic fuel consumption.

The planning figure for fuel consumption of supply units in the data base is lower than for the tactical units because there are no tactical vehicles that had high rates of fuel consumption included in the support units. The consumption rate in the data base for the supply unit is 0.3 gallons per person per day. This value is used for the same reason 2.8 gallons per person per day was used for the MEU. Therefore, the fuel consumption for the MSSG is:

283 x 0.3 = 849 gals per day or 212 gals every 6 hrs.

Ammunition consumption is calculated for each combat system per hour. In the data base there is a consumption rate for each system. In JTLS, the attrition of combat systems is calculated by "a mixed, heterogeneous, time-stepped Lanchestrian attrition model...[which] models direct fire and organic indirect fire attrition between two units in combat (in the same or adjacent hexes)." [Ref. 19] Because of this attrition model, the total number of combat systems a unit has will decrease for each hour that unit is in combat, but each will use a fixed quantity of ammunition per hour of combat. Tables 3 and 4 show how the Class V ammunition consumption and resupply rates were calculated for the MEU and MSSG, respectively.

Combat System	Number of systems	Hourly consumption	Six hour resupply
Infantry	735	0.006 x 735 = 4.41	26.46
Other-Troops	735	0.005 x 735 = 3.68	22.08
Small- arms	273	0.0112 x 273 = 3.06	18.36
Lt- Mortars	9	.05 x 9 = 0.45	2.5
Hvy- Mortars	8	.08 x 8 = 0.64	3.84
Total		12.24	73.24

Table 3. Ammunition Consumption Rates For The MEU (lbs/man/hour).

Combat System	Number of systems	Hourly consumption	Six hour resupply
Other-Troops	283	0.005 x 283 = 1.415	8.49
Small- Arms	13	0.0112 x 13 = 0.1456	0.87
Total		1.56	9.36

Table 4. Ammunition Consumption Rates For The MSSG (lbs/man/hour).

E. AMPHIBIOUS OPERATIONS IN JTLS

For this thesis only the logistics support of amphibious operations was analyzed. In the scenarios discussed in Chapter IV, the assault phase has been conducted with the MEUs and MSSG's already ashore. The Joint Theater Level Simulation does not have the fidelity to model the individual logistic runs from the naval ships to the beach. Therefore, to simulate that these logistics runs were occurring, an automatic resupply of fuel was established to be delivered to the MSSGs every six hours. Because the MSSGs have their own capability of make drinking water from salt water by using a reverse osmosis water purification unit (ROWPU), an automatic login of water was established to arrive every six hours. The ROWPU has the capability to produce 500 gallons of water per hour. The

MSSGs have two ROWPUs; therefore, giving them the capability to produce 1000 gallons of water per hour. The six hour automatic water logins were set for 3000 gallons every six hours. The resupply of ammunition was set to be ordered from the naval shipping on an as-needed basis.

IV. DATA ANALYSIS

A. SCENARIO DESCRIPTIONS

Two scenarios were used for this analysis both set in the Southwest Asian theater of operations. Both scenarios start with Coalition forces, U.S. Naval forces and U.S. Marines already deployed in theater and the U.S. Army just starting to arrive. The difference in the two scenarios is that in Scenario 1 (Heavy) the Iraqi forces have displaced all Kuwaiti combat forces into Saudi Arabia and the Iraqi forces have taken up defensive positions along the Kuwait and Saudi Arabian boarder. In Scenario 2 (Light) the Iraqi forces have deployed along the Iraq and Kuwait boarder but they have not begun an offensive operation into Kuwait. Because of the two different Iraqi postures, the U.S. and Coalition forces are deployed differently for the two scenarios. The specifics of these differences is discussed in the following paragraphs. For this thesis, only the amphibious forces are analyzed, which include four units: 13 MEU, 24 MEU, MSSG 13 and MSSG 24. These MSSGs are supported by two naval shipping units: LHA-1 and LHA-2.

1. Scenario 1

This scenario has two variations: Heavy 1 and Heavy 2. The first, Heavy 1, has the U.S. Army arriving into Saudi Arabia as the Iraq forces begin an attack across the boarder towards the coalition forces defending King Khalid Military City (KKMC) to seize the Trans-Arab pipeline and control the flow of oil in northern Saudi Arabia. In the second variation, Heavy 2, all the U.S. Army forces are deployed in theater before the

same advance by Iraq is initiated. Embedded in these two scenarios are the amphibious scenarios, Marine Heavy 1 and 2, respectively.

a. Build-up

As shown in Figure 6, the two MEUs are deployed along the Saudi Arabian coastline at Al-Khafji with the MSSGs approximately 16 KM to the south (also along the coast) in both Marine Heavy 1 and 2. Their mission is to stop any Iraqi forces from advancing south along the Saudi Arabian coast.

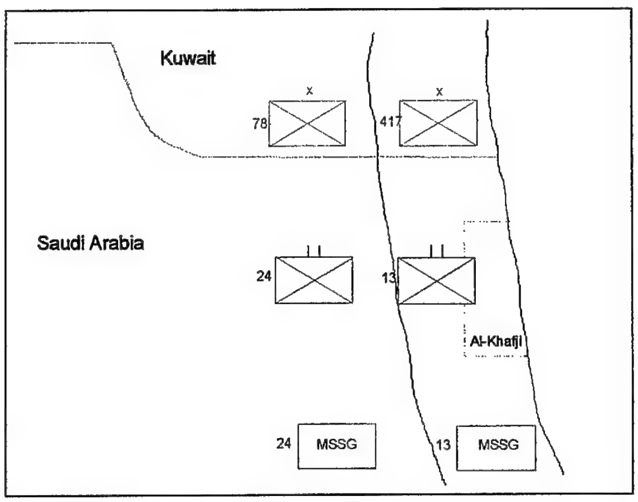

Figure 6. Build-up phase for Marine Heavy 1 and 2.

b. Marine Heavy 1

At 2913000Z Dec 90 the Iraqi forces attack south with the 417th Infantry Brigade into Saudi Arabia and are engaged by both MEUs. At the same time, an Iraqi air attack is made on MSSG 13. Severe damage is done to MSSG 13's on-hand supplies. By 300001Z Dec 90 the Iraqi forces have been significantly attrited and begin to withdraw back into Kuwait.

At 301200Z Dec 90 the MEUs begin a counterattack against the Iraqi forces that have withdrawn back into Kuwait. The objective of this counterattack is to push the Iraqi forces back into Iraq and once again establish Kuwait as a sovereign state.

c. Marine Heavy 2

A second run of this scenario was executed except that there was no attack by Iraqi forces into Saudi Arabia and no Iraqi air attack against MSSG 13. In this scenario the MEUs go on the offensive and conduct an attack against the Iraqi forces along the border to push the Iraqi forces back into Iraq and establish Kuwait as a sovereign state. The 24th MEU attacks the 78th Infantry Brigade and 13 MEU attacks the 412th Infantry Brigade.

2. Scenario 2

This scenario also has two variations: Light 1 and Light 2. The first, Light 1, has the U.S. Army arriving into Kuwait and Saudi Arabia as the Iraq forces begin an attack across the Kuwait boarder towards the U.S. forces defending Doha and Kuwait City. The Iraqi forces' objective is to push all coalition forces out of Kuwait and claim Kuwait as part of Iraq. In the second variation, Light 2, all the U.S. Army forces are deployed in theater before the same advance by Iraq is initiated. Inside these two scenarios are the amphibious scenarios, Marine Light 1 and 2, respectively.

a. Build-up

As shown in Figure 7, the two MEUs are deployed north of Doha with the

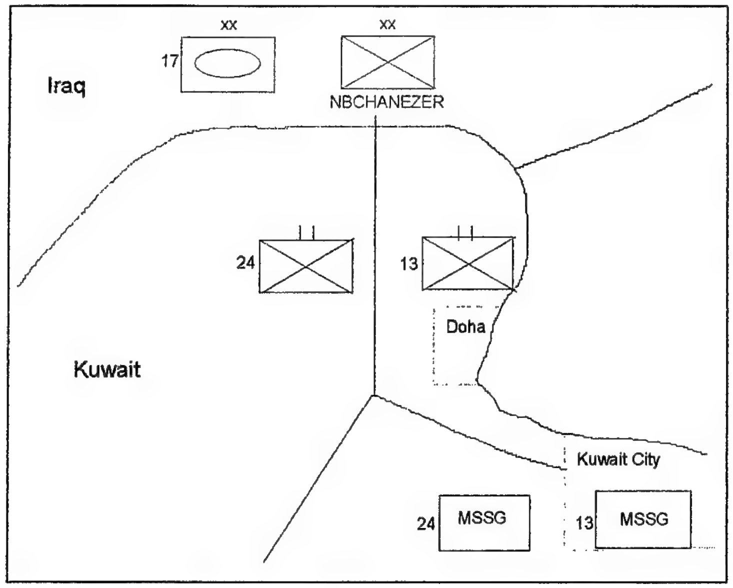

Figure 7. Build-up phase Marine Light 1 and 2.

MSSGs deployed south of Kuwait City for both scenarios. Their mission is to stop any Iraqi forces from advancing south into Doha.

b. Marine Light 1

At 2818000Z Dec 90 the Iraqi forces attack south into Kuwait and the Neber Chanezer Republican Guard Division is engaged by 13 MEU. No Iraqi forces are engaged by 24 MEU. At 281830Z Dec 90 an Iraqi air attack hits MSSG 13. Severe damage is done to MSSG 13's on-hand supplies. By 290000Z Dec 90 the Iraqi forces have been significantly attrited and begin to withdraw back into Iraq.

At 290600Z Dec 90 the two MEUs begin a counterattack against the Iraqi forces that have withdrawn back into Iraq. The objective of this counterattack is to push the Iraqi forces back from the Kuwait and Iraq boarder. This will ensure that Kuwait will remain a sovereign state.

c. **Marine Light 2**

At 2818000Z Dec 90 the Iraqi forces attack south into Kuwait and the Neber Chanezer Republican Guard Division is engaged by 13 MEU and the 17th Armor Division is engaged by 24 MEU. At 281830Z Dec 90 an Iraqi air attack hits MSSG 13. Severe damage is done to MSSG 13's on-hand supplies. By 290000Z Dec 90 the Iraqi forces have been significantly attrited and begin to withdraw back into Iraq.

At 290600Z Dec 90 the two MEUs begin a counterattack against the Iraqi forces that have withdrawn back into Iraq. The objective of this counterattack is once again to push the Iraqi forces back from the Kuwait and Iraq boarder to ensure that Kuwait will remain a sovereign state.

B. OUTPUT FILE DESCRIPTION

During the execution of both scenarios the data are sent to files in the post processor. The data for this thesis were stored in the postprocessor file labeled Supply, which contain the supply data for all units. A program written by Rolands and Associates sorted the amphibious units' data from the Supply file. A file for each scenario was created and then loaded to a 3.5" disk for analysis. Numerous iterations of Marine Light 2 were run until the information needed for this thesis was present in the downloaded files. All changes to the model and to the postprocessor are now included in JTLS.

Table 5 shows a partial sample of the original data for Marine Light 2. The file, downloaded by Rolands and Associates, was then imported into an *Excel* spread sheet. Because of the length of the initial file, only the initial and final entries are shown

(Appendix D). Table 5 is color coded to indicate data manipulation required for analysis. The color coding is as follows:

1. Black - original data
2. Blue - deleted data
3. Green - added data.

Time	Unit	Supply Index	Status	Action	Supplies
0	13MEU.SOC	4	1	4100	8000
0	13MEU.SOC	4	4	4100	0
0.02	13MEU.SOC	4	1	4103	8000
0.25	13MEU.SOC	4	1	4103	8000
0.25	13MEU.SOC	4	1	4403	6177.02
0.25	13MEU.SOC	4	1	4403	6177.02
0.25	13MEU.SOC	4	4	4404	1822.98
0.47	13MEU.SOC	4	4	4417	0
0.47	13MEU.SOC	4	1	4403	6177.02
0.47	13MEU.SOC	4	1	4408	8577.02
0.47	13MEU.SOC	4	1	4408	8577.02
0.47	13MEU.SOC	4	1	4408	8000
0.47	13MEU.SOC	4	1	4411	8000
0.47	13MEU.SOC	4	1	4411	8000
0.47	13MEU.SOC	4	1	4411	8000
0.47	13MEU.SOC	4	1	4412	8000
0.47	13MEU.SOC	4	1	4412	8000
0.5	13MEU.SOC	4	1	4403	8000
0.5	13MEU.SOC	4	1	4403	6018.5
0.5	13MEU.SOC	4	1	4403	6018.5
0.71	13MEU.SOC	4	1	4408	8510.37

Table 5. Sample *Excel* Spread Sheet.

The meaning of the numbers in the third, fourth and fifth columns can be found in Appendices E, F and G, respectively. Some data were deleted because either the status was not on-hand, the action code did not warrant displaying, or it was duplicate data. The reason for adding data was to show what was on-hand prior to the next line of data.

These additional data allowed the graph to be displayed consistent with the time step structure of the outputs.

C. CREATION OF THE GRAPHS

Table 6 is a partial spreadsheet of the data with Blue data removed from Table 5. The last column in this table, labeled Plan, shows the supplies that the unit expected to

Time	Unit	SupplyIndex	Status	Action	Supplies	Plan
0.02	13MEU.SOC	4	1	4103	8000	8000
0.25	13MEU.SOC	4	1	4103	8000	6177.02
0.25	13MEU.SOC	4	1	4403	6177.02	8000
0.47	13MEU.SOC	4	1	4403	6177.02	6229.55
0.47	13MEU.SOC	4	1	4408	8000	6229.55
0.5	13MEU.SOC	4	1	4403	8000	6018.5
0.5	13MEU.SOC	4	1	4403	6018.5	8000
0.71	13MEU.SOC	4	1	4403	6018.5	6311.98
0.71	13MEU.SOC	4	1	4408	8000	6311.98
0.75	13MEU.SOC	4	1	4408	8000	6018.5
0.75	13MEU.SOC	4	1	4403	6018.5	8000

Table 6. Partial Sample Of The Data Used For Analysis.

have on-hand if everything happened according to the logistics plan of execution for this scenario. This Plan column was added so that what actually took place during the scenario and what was planned could be compared.

Appendix H contains the steps for creating the graphs in the *Excel* spreadsheet.

D. ANALYSIS OF THE GRAPHS

From the data of the four scenarios, with four units in each scenario and three attributes per unit, 48 graphs can be produced. In this section four of these graphs will be analyzed. On all graphs, the black curve shows what was planned and the red curve depicts what actually took place.

The first graph to be analyzed is given in Figure 8. It shows 13 MEU's water on-

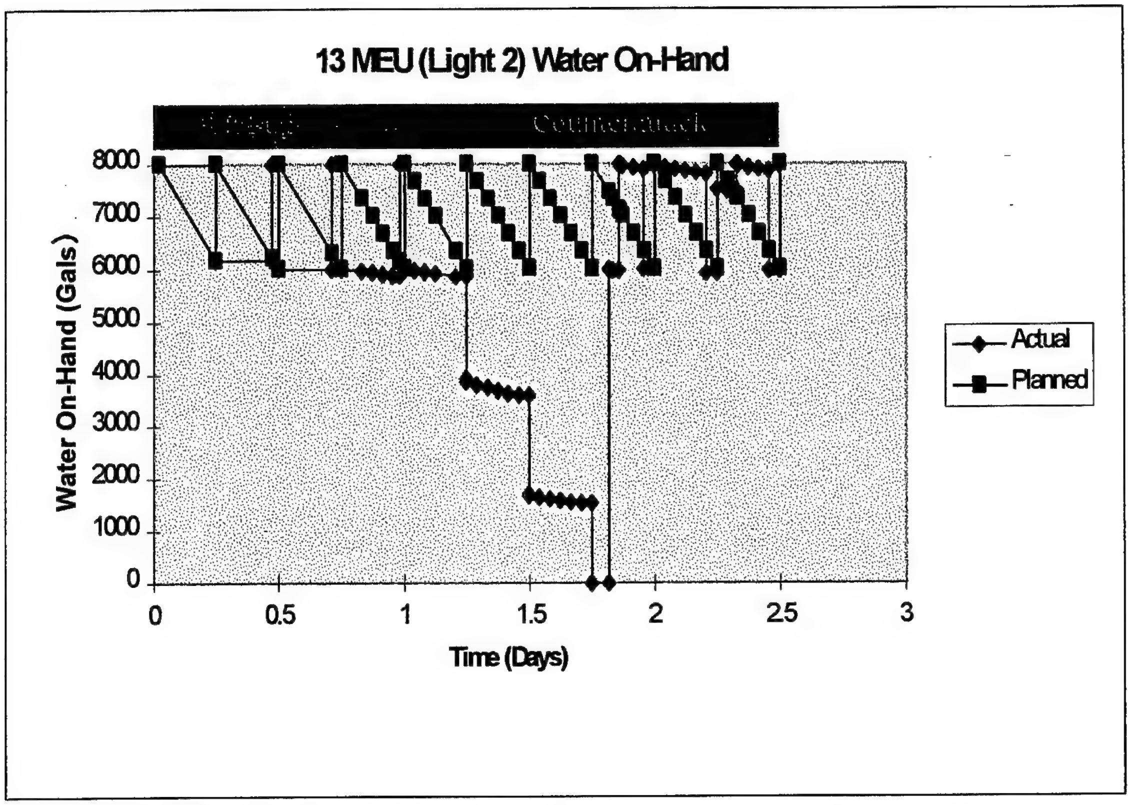

Figure 8. 13 MEU's Water On-hand During Marine Light 2.

hand during Marine Light 2. During the build-up phase and through the defensive phase the water on-hand follows the plan closely. But once 13 MEU starts its counterattack the water trucks are not getting to the MEU in a timely fashion. Investigation of the reasons

for this reveal that the water trucks are traveling at the same speed that the MEU is advancing during the counterattack. Therefore, the water trucks only catch up to the MEU when the MEU stops to conduct its attack against the Iraqi forces. Thus, a large resupply occurs at Day 1.8 as the trucks reach the MEU. This critical event (13 MEU's water level dropping to zero) does not effect 13 MEU's mission because the MEU is resupplied within 4.8 hours of the occurrence of this critical event. If the time between the occurrence of the critical event and the resupply had been longer, this critical event could have been very detrimental to the MEU's mission.

Figure 9 shows MSSG 13's on-hand water supply during Marine Light 2. Two

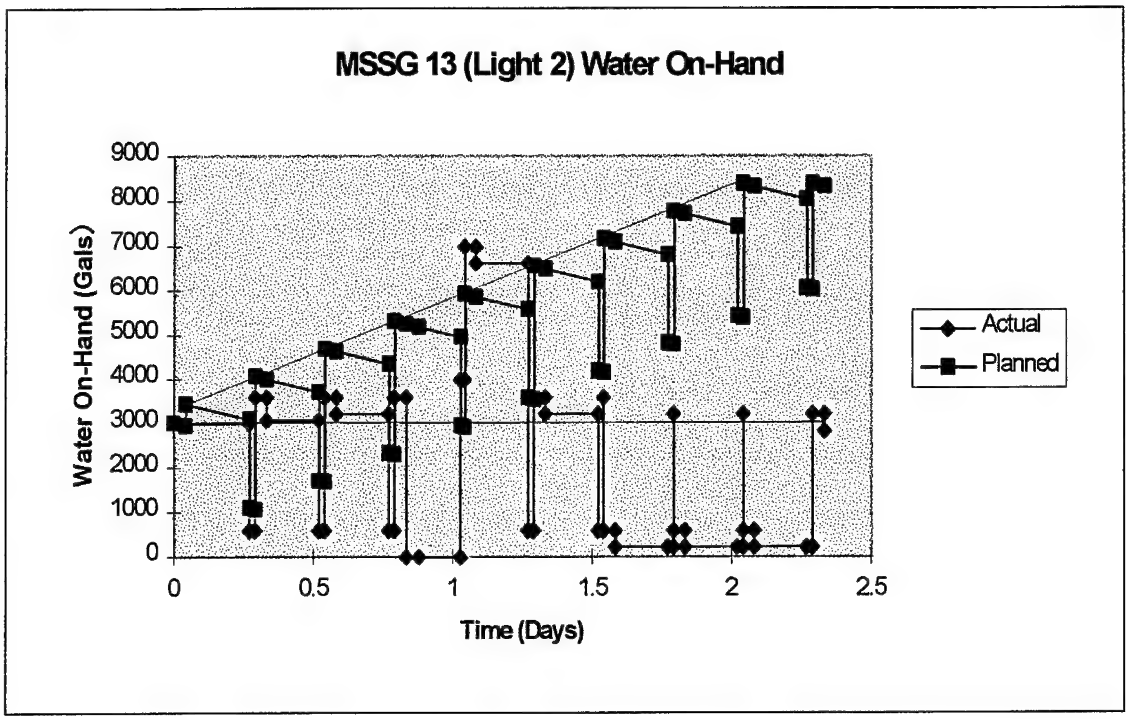

Figure 9. MSSG 13's Water On-hand During Marine Light 2.

main differences are noticed between the planned curve and the actual curve. First, the planned curve, the green line, shows a steady increase in the water on-hand. The actual curve shows a steady level of water on-hand displayed by the blue line, except for the time just before the end of the first day. This exception will be discussed later. The difference in these two curves is that the plan sends the MEU what it ordered and the simulation always sends the MEU 70% of the MSSG's water on-hand. This occurs in the model because the supply units are programmed to always top off the trucks carrying wet supplies. The water and fuel trucks in the sustainment logistics prototype (SLP) are 10,000 gallon trucks which are always able to hold more than 70% of the MSSG's water. Also included in the SLP is a constraint that only allows a support unit to ship down to 30% of its on-hand wet supplies. Both the 10,000 gallon trucks and the 30% figure can be adjusted by creating a new SLP just for the MSSGs instead of sharing the SLP that is created for all the supply units in this JTLS data base. To change the model so that only what is ordered is what is shipped requires a modification of the actual model code.

The reason for the second noticeable difference between the two curves at approximately Day 0.8 is due to the very successful Iraqi air strike on MSSG 13. This air strike caused, MSSG 13 to loose approximately 3600 gallons of water and 350 gallons of fuel. The large delivery of water at approximately Day 1 is due to the arrival of the scheduled login of 3000 gallons of water and a delivery of 4000 gallons of water that was ordered by the MSSG when all of its water was destroyed by the Iraqi airstrike. Because the time between MSSG 13's loss of water and resupply is only 4.8 hours, there

is no noticeable effect on MSSG 13's conduct of its mission. Once again, if this time between the occurrence of the critical event and the resupply had been longer, this critical event could have been very detrimental to the MSSG's mission.

The third graph, given in Figure 10, shows 24 MEU's fuel on-hand during Marine

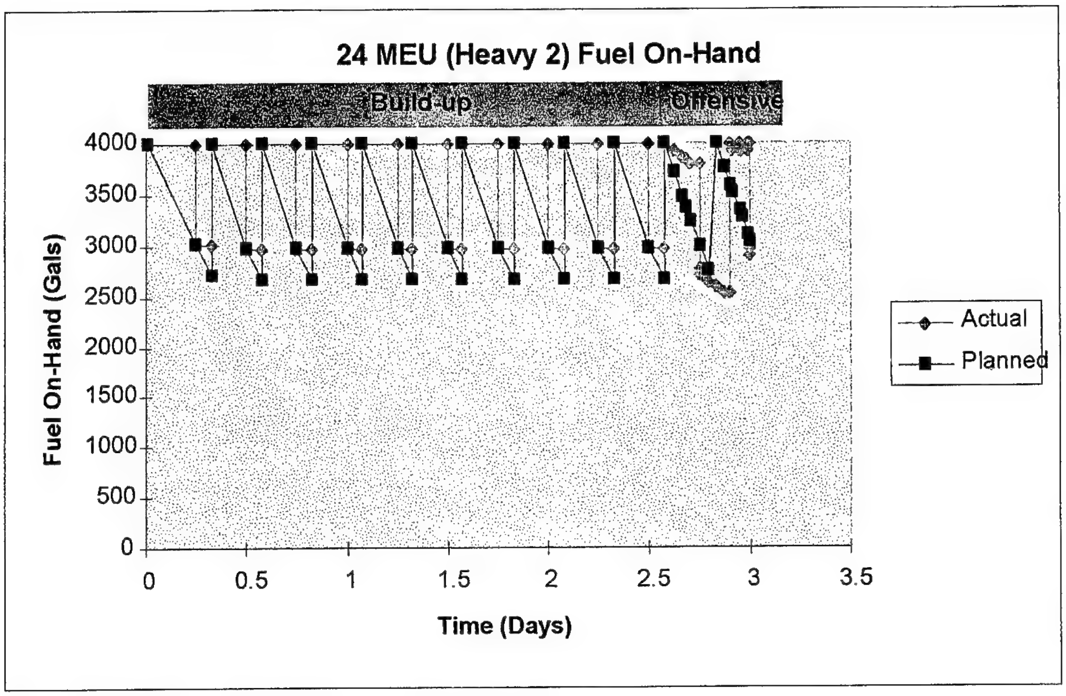

Figure 10. 24 MEU's Fuel On-Hand During Marine Heavy 2.

Heavy 2. This graph demonstrates a case where what actually took place during the CAX matches the plan very closely. The only minor difference is during the build-up phase the planned graph dips below the actual graph. This is caused because JTLS, a time stepped model, does not account for the usage of supplies between the usage step and the resupply step. As the graph shows, this is only a minor error and has no effect on the MEU's mission.

The final graph, given in Figure 11, shows 13 MEU's ammo on-hand during

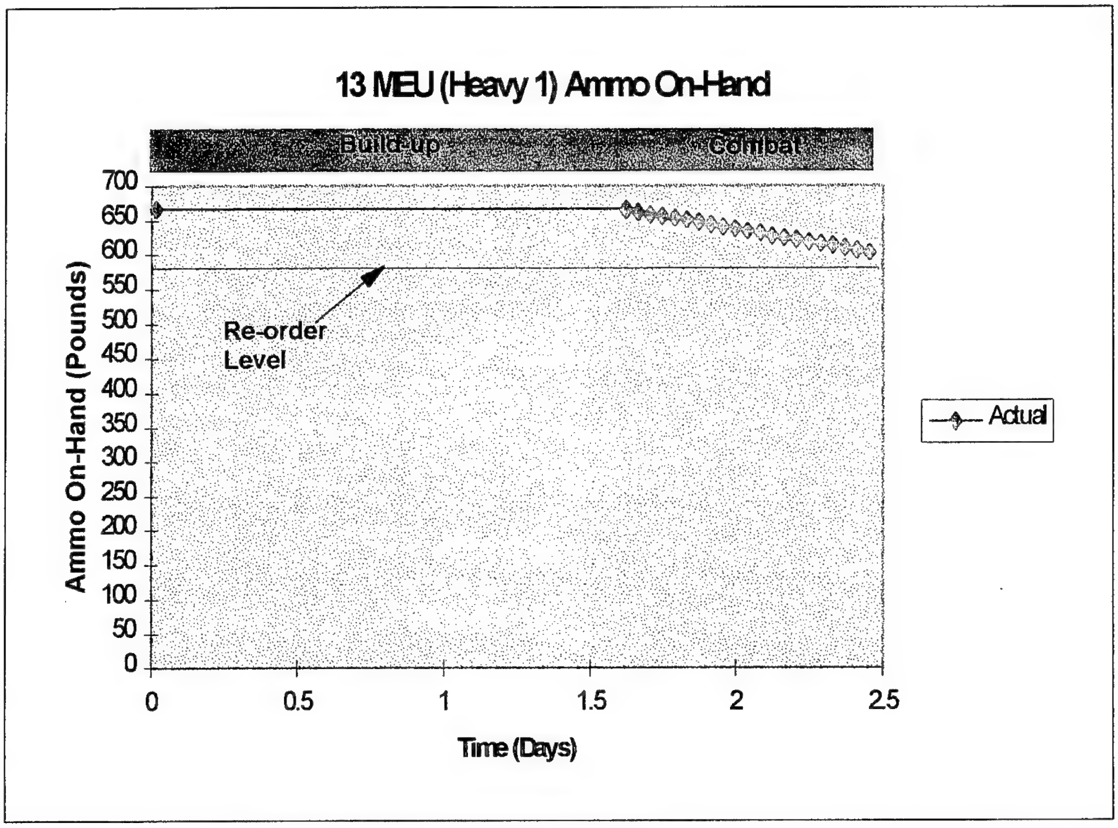

Figure 11. 13 MEU's Ammo On-Hand During Marine Heavy 1.

Marine Heavy 1. There is no planned (black line) consumption for ammo because ammo is only consumed during combat, and is unknown. Therefore, the resupply plan was to give the MEU's two days of supplies (668 lbs) of ammo and set a reorder level (the purple line) for ammo at 585 lbs. This plan makes sure that the MEU's order ammo with enough time for their resupplies to arrive prior to them running out of ammo. This graph is very typical for the ammo data for both MEU's in all four scenarios. No matter which scenario is looked at, the MEUs never reach their resupply level. Therefore, in this thesis ammo is never involved in a critical event.

V. CONCLUSIONS AND RECOMMENDATIONS

> After Action Reviews (AAR) are not critiques, they do not determine success or failure; rather they are professional discussions of training events...AARs tell a story about what was planned, what happened, why it happened and what could have been done differently to improve performance. [Ref. 20]

A. CONCLUSIONS

This research develops an AAR for logistics functions in JTLS as they pertain to specific tasks in the UJTL. The concentration of this research is on the resupply and usage of water, ground fuel and ammunition. It is demonstrated how to send the data produced during a CAX to a postprocessor and then sort the data using the program created by Rolands and Associates into files. These files are imported into an *Excel* spreadsheet to create the graphs needed for the AAR. During the analysis of the *Excel* spreadsheets, the following corrections and improvements were made to JTLS and its postprocessor files:

1. On-hand quantities of wet supplies need to be decremented when the unit sends a truck convoy.

2. Supply categories, not including fuel, need to be reported when the unit has "due in" or "owed to others" quantities.

3. The postprocessor needs to write out the amount of supplies on-hand after a login or after a convoy arrives.

During the initial, mid and final planning conferences, the AAR group should determine what files the postprocessor creates to enable the AAR group to develop appropriate graphs. Also, because these files are produced throughout the exercise, when the commanders pause the scenario to review how the exercise is progressing, these graphs can be produced for a quick analysis.

B. RECOMMENDATIONS

1. JTLS

The following recommendations allow JTLS to better represent the *real* world. First, allow all convoys or single trucks to return to their parent unit with all unused supplies instead of having them redistribute these supplies to other units with the same SLP. This would then resemble the current policy of each service being responsible for the logistics support of its own forces [Ref. 13]. Secondly, delete the factitious dumps that are currently made when excess supplies are brought to combat units [Ref. 19]. This represents a storage capability that these units will never have. Thirdly, change the single stockage objective for all wet supplies. Because wet supplies, such as fuel and water, can not be stored in the same containers, the storage objectives should be separated into individual levels. This can be accomplished by deleting the overall stockage objective for wet supplies and adding another data item for each wet item which would represent their appropriate stockage level. Finally, change the way fuel burned is represented.

Currently it is decremented by gallons per person per day [Ref. 19]. This should be changed to gallons per vehicle per day.

2. Postprocessor

The first recommendation for the postprocessor is to delete all duplicated items sent to it by the model. This will delete most of the blue color coded data in Table 5 and reduce the time spent to produce Figure 8. The other recommendation for the postprocessor is to have the model record the previous on-hand supplies and the new on-hand supplies whenever the unit's on-hand supplies are updated. This will delete all the green color coded data in Tables 5 and 6. Then, the only data that would have to be added to the files are the data that create the logistics plan for the exercise. With these two changes the output files from the postprocessor will have only minor modifications to be made to produce the graphs for the AAR.

3. AAR

The results of eight Naval Postgraduate School student thesis [Ref. 2-8] have shown that causal audit trails for critical events can be graphically displayed for representation in an AAR. For each exercise, it must be determined which joint tasks from the UJTL are needed for representation in the AAR. To accomplish this, an overall list of all joint tasks that might be needed for the AAR must be created. Once this is established, an expert for each joint task needs to be selected. Next, scenarios need to be run, similar to those run for this thesis, and these experts attempt to create their reports. These initial attempts may fail because, as was discovered during this thesis research, what one believes

will be in the postprocessor files might not really be present. Therefore, these experts need to interact with the programmers and make sure exactly what they need is written to the postprocessor. Once this is accomplished, the AARs will be more meaningful because they will be based on the quantitative causal audit trails represented by the graphs that were created from the data produced during the CAX.

APPENDIX A. PARTIAL DENDRITIC DIAGRAMS

Appendix A contains the partial dendritic diagrams for fuel and water. Both of the partial dendritic diagrams are discussed in Chapter III. Figure 12 is the partial dendritic diagram for fuel and Figure 13 is the partial dendritic diagram for water.

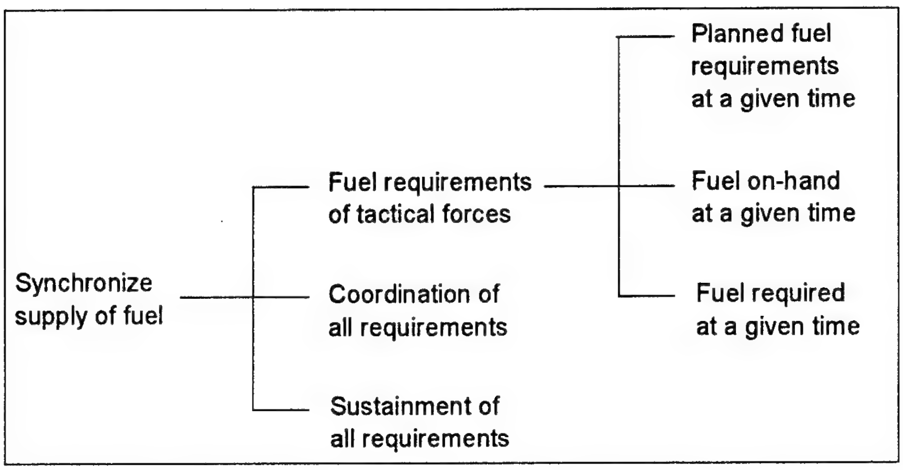

Figure 12. Partial Dendritic Diagram For Fuel.

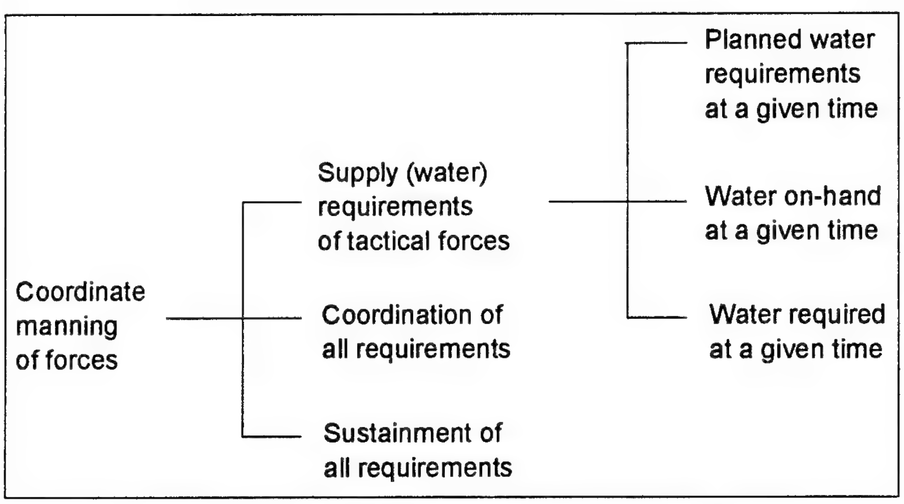

Figure 13. Partial Dendritic Diagram For Water.

APPENDIX B. TACTICAL UNIT PROTOTYPES

Appendix B contains the Tactical Unit Prototypes for the MSSGs and the MEUs. Type 40 is for the MSSGs and Type 69 is for the MEUs.

Tactical Unit Prototype AMPHIB.BN.1 (Type 69) Data

TUP Combat System Data   Units Using This TUP
TUP Supply Category Data

Graphics Symbol:	23, MARINE.AMPHIB.UNIT
Caliber Of Artillery That Can Be Fired:	1
Average Speed Over Open Terrain:	50.00 Km/Hr
Radius, For Area Weapon Assessment:	2500.00 Meters
Range Of Organic Ground Intel Assets:	15.00 Km
Range Of Organic Air Intel Assets:	0. Km
Mean Time Between Organic Ground Intel Reports:	7.99 Hours
Mean Time Between Organic Air Intel Reports:	24.00 Hours
Attack To Defend Threshold:	.7000000
Defend To Delay Threshold:	.5000000
Delay To Withdraw Threshold:	.4000000
Incapable Threshold:	.3000000
Wiped Out Threshold:	.1000000
Mean Time To Repair A Runway:	2.40 Hours
Maximum Number Of Simultaneous Runway Repairs:	3
Amphibious Boat Type Used:	AAV_7A1
Capacity To Store Dry Supplies:	15096.66 Tons
Capacity To Store Wet Supplies:	12000.00 Gallons
Capacity To Carry Dry Supplies:	15096.66 Tons
Capacity To Carry Wet Supplies:	12000.00 Gallons

Default Distribution Of Combat Power (Dir 1 Is Orientation):

Dir 1: .20000

Dir 6: .16000   Dir 2: .16000

Dir 5: .16000   Dir 3: .16000

Dir 4: .16000

Combat Power Able To Reorient Per Combat Assessment Is: 1.00000

The Three Most Important Combat Systems Of Units Using This Prototype Are:

Most Significant:	SMALL-ARMS
Next Most Significant:	AFV
Third Most Significant:	MAW-ATGM

A Unit Using TUP AMPHIB.BN.1 Has The Following TOE And SCORE Values:

Combat System	TOE	SCORE
INFANTRY	735.00	1.00
OTHER-TROOPS	735.00	1.00
NONCOMBATANT	0.	1.00
SMALL-ARMS	273.00	4.00
LAW-ROCKET	0.	4.00
MAW-ATGM	24.00	5.00
HAW-ATGM	0.	6.00
NLOS-AT	0.	20.00
LT-MORTARS	9.00	10.00
HV-MORTARS	8.00	15.00
HOWITZER-LT	0.	10.00
HOWITZER-MED	0.	12.00
SP-HV-HWTZR	0.	20.00
ROCKETS	0.	10.00
MLRS	0.	20.00
TANK-HVY	0.	50.00
TANK-MED	0.	40.00
TANK-LT-ABN	0.	20.00
AFV	12.00	25.00
APC	6.00	10.00
OTH-TRP-CARR	0.	10.00
TRUCKS-CARGO	0.	5.00
TRUCKS-TANKE	0.	5.00
UTILITY-TRK	17.00	1.00
AIRCRAFT	0.	100.00
C3I	3.00	100.00

A Unit Using TUP AMPHIB.BN.1 Has The Following Supply Category Related Values:

Supply Category	Bring to Theater	Reorder Level	Stockage Objective	Basic Load	Normal Consumption	Usage Attack	Usage Defend	Usage Delay
COMBATANTS	147.05000	120.00000	147.05000	147.05000	0.	0.	0.	0.
NON-CMBT-PER	0.	0.	0.	0.	0.	0.	0.	0.
CL.I	11.60000	9.86000	11.60000	6.96000	.00200	.00013	0.	.00013
CL.I.W	8000.00000	7000.00000	8000.00000	6000.00000	5.39000	.04166	.02080	.04166
CL.II	0.	0.	0.	0.	0.	0.	0.	0.
CL.III.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.III.W	4000.00000	3500.00000	4000.00000	4000.00000	2.80000	.04000	.02000	.04000
CL.IV	0.	0.	0.	0.	0.	0.	0.	0.
CL.V	668.00000	585.00000	668.00000	668.00000	0.	0.	0.	0.
CL.V.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.NAVY	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.MINES	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.TORP	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-SR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-MR1	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-MR2	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-LR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-IR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-LG	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-TV	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-RDR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.ASWIRE	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.LGB-1	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.LGB-2	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-SR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-MR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-LR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SS-SR	8.64000	7.34400	8.64000	8.64000	0.	0.	0.	0.
CL.V.SS-MR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SS-LR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.N	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.W.ICM	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.Z.CHEM	0.	0.	0.	0.	0.	0.	0.	0.
CL.VI	0.	0.	0.	0.	0.	0.	0.	0.
CL.VII	288.20000	260.00000	288.20000	288.17000	0.	0.	0.	0.
CL.VII.AIR	0.	0.	0.	0.	0.	0.	0.	0.

The Following Units Use Tactical Unit Prototype AMPHIB.BN.1

13MEU.SOC 24MEU.SOC

Tactical Unit Prototype MSSG.1 (Type 40) Data

TUP Combat System Data
TUP Supply Category Data

Units Using This TUP

Graphics Symbol:	60, SUPPORT
Caliber Of Artillery That Can Be Fired:	NONE
Average Speed Over Open Terrain:	50.00 Km/Hr
Radius, For Area Weapon Assessment:	1500.00 Meters
Range Of Organic Ground Intel Assets:	25.00 Km
Range Of Organic Air Intel Assets:	0. Km
Mean Time Between Organic Ground Intel Reports:	12.00 Hours
Mean Time Between Organic Air Intel Reports:	24.00 Hours
Attack To Defend Threshold:	.7000000
Defend To Delay Threshold:	.5000000
Delay To Withdraw Threshold:	.4000000
Incapable Threshold:	.3000000
Wiped Out Threshold:	.1000000
Mean Time To Repair A Runway:	2.40 Hours
Maximum Number Of Simultaneous Runway Repairs:	3
Amphibious Boat Type Used:	NONE
Capacity To Store Dry Supplies:	10000.00 Tons
Capacity To Store Wet Supplies:	5000000.00 Gallons
Capacity To Carry Dry Supplies:	10000.00 Tons
Capacity To Carry Wet Supplies:	5000000.00 Gallons

Default Distribution Of Combat Power (Dir 1 Is Orientation):

Dir 1: .20000

Dir 6: .16000 Dir 2: .16000

Dir 5: .16000 Dir 3: .16000

Dir 4: .16000

Combat Power Able To Reorient Per Combat Assessment Is: 1.00000

The Three Most Important Combat Systems Of Units Using This Prototype Are:

Most Significant:	TRUCKS-CARGO
Next Most Significant:	TRUCKS-TANKE
Third Most Significant:	NONE

A Unit Using TUP MSSG.1 Has The Following TOE And SCORE Values:

Combat System	TOE	SCORE
INFANTRY	0.	1.00
OTHER-TROOPS	283.00	1.00
NONCOMBATANT	0.	1.00
SMALL-ARMS	13.00	4.00
LAW-ROCKET	0.	4.00
MAW-ATGM	0.	5.00
HAW-ATGM	0.	6.00
NLOS-AT	0.	20.00
LT-MORTARS	0.	10.00
HV-MORTARS	0.	15.00
HOWITZER-LT	0.	10.00
HOWITZER-MED	0.	12.00
SP-HV-HWTZR	0.	20.00
ROCKETS	0.	10.00
MLRS	0.	20.00
TANK-HVY	0.	50.00
TANK-MED	0.	40.00
TANK-LT-ABN	0.	20.00
AFV	0.	25.00
APC	0.	10.00
OTH-TRP-CARR	0.	10.00
TRUCKS-CARGO	37.00	5.00
TRUCKS-TANKE	20.00	5.00
UTILITY-TRK	2.00	1.00
AIRCRAFT	0.	100.00
C3I	2.00	100.00
CL.VII.OTHER	0.	0.

A Unit Using TUP MSSG.1 Has The Following Supply Category Related Values:

Supply Category	Bring to Theater	Reorder Level	Stockage Objective	Basic Load	Normal Consumption	Usage Attack	Usage Defend	Usage Delay
COMBATANTS	28.31000	20.00000	28.31000	28.31000	0.	0.	0.	0.
NON-CMBT-PER	0.	0.	0.	0.	0.	0.	0.	0.
CL.I	10.38730	8.82921	10.38730	.98400	.00200	.00013	0.	.00013
CL.I.W	2000.00000	2000.00000	3000.00000	2000.00000	5.39000	.04166	.02080	.04166
CL.II	.34985	.29737	.34985	.03936	0.	0.	0.	0.
CL.III.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.III.W	5000.00000	4000.00000	5000.00000	4000.00000	.30000	.04000	.01000	.04000
CL.IV	.42481	.36109	.42481	.04920	0.	0.	0.	0.
CL.V	375.00000	300.00000	400.00000	375.00000	0.	0.	0.	0.
CL.V.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.NAVY	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.MINES	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.TORP	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-SR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-MR1	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-MR2	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AA-LR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-IR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-LG	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-TV	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.AS-RDR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.ASWIRE	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.LGB-1	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.LGB-2	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-SR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-MR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SA-LR	84.05000	67.24000	84.05000	0.	0.	0.	0.	0.
CL.V.SS-SR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SS-MR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.SS-LR	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.N	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.W.ICM	0.	0.	0.	0.	0.	0.	0.	0.
CL.V.Z.CHEM	0.	0.	0.	0.	0.	0.	0.	0.
CL.VI	.34985	.29737	.34985	.03936	.00008	0.	0.	0.
CL.VII	.40000	.34000	.40000	.40000	0.	0.	0.	0.
CL.VII.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.VII.AMPHI	0.	0.	0.	0.	0.	0.	0.	0.
CL.VII.CBT-V	0.	0.	0.	0.	0.	0.	0.	0.
CL.VIII	5.00000	3.00000	6.00000	2.00000	.00500	0.	0.	0.
CL.IX	0.	0.	0.	0.	0.	0.	0.	0.
CL.IX.AIR	0.	0.	0.	0.	0.	0.	0.	0.
CL.X	0.	0.	0.	0.	0.	0.	0.	0.
CL.X.D.CIV-V	0.	0.	0.	0.	0.	0.	0.	0.
CL.X.G.COMM	0.	0.	0.	0.	0.	0.	0.	0.
CL.X.K.TAC-V	0.	0.	0.	0.	0.	0.	0.	0.
LEAFLET	0.	0.	0.	0.	0.	0.	0.	0.

The Following Units Use Tactical Unit Prototype MSSG.1

MSSG.13 MSSG.24

APPENDIX C. SUSTAINMENT LOGISTICS PROTOTYPE

Appendix C contains Sustainment Logistics Prototype 1. Sustainment Prototype 1 is used for all U.S. forces.

```
Sustainment Logistics Prototype SLP_1 (Index 1) Data

     MHE Requirements                       % Recoverable Supplies
     Convoy Related Data                    % Usable Dumped Supplies
     Supply Related Data                    Using Factions

Units Can Support SAM/AAA Sites Within A Distance Of:    400.00    Km
Explicit Convoys Are Required Beyond:                     15.00    Km
Explicit Convoy Speed:                                   480.00    Km/Day
Implicit Convoy Speed:                                   480.00    Km/Day
Time To Dispatch An Implicit Convoy:                       .04167  Days
Time To Receive An Implicit Convoy:                        .04167  Days
Speed Of A Barge Convoy:                                 360.00    Km/Day
Maximum Distance For Mandatory Transfer:                  30.00    Km
Time To Complete A Mandatory Transfer:                     .12500  Days
Time To Receive A Requisition:                             .02083  Days

Days Of Supply Forward Accompanying Combat Systems
During Unit Air Moves:                                     .33333  Days
Days Of Supply Forward Accompanying Combat Systems
During Amphibious Assault Or Extraction:                  1.00000  Days

Units Using This SLP Report When Below This Fraction
Of Basic Load In Any Category:                             .20000

Amount Of Class IV Supplies Consumed Per Runway Repair:    5.00    Tons

Transportation Class Used For Cargo Trucks:          BLUE.CARGO
Transportation Class Used For Tanker Trucks:         BLUE.TNKR

Percentage Of Sorties Flown In Last Adjust Surge
Period That Affect Maintenance Now Is:               30.00000
Percentage Of Sorties Flown 2 Adjust Surge Periods
Ago That Affect Maintenance Now Is:                  20.00000
Percentage Of Sorties Flown 3 Adjust Surge Periods
Ago That Affect Maintenance Now Is:                  10.00000

SLP SLP_1 MHE Requirements For On/Offloading

                  0 = Do Not Use, 1 = Required, 2 = Optional
Transportation Method |  Barge     Rail     Truck   Airlift   Sealift
----------------------|--------------------------------------------
  MHE Requirement     |   2         2         2        2         2
```

SLP SLP_1 Convoy Related Data

Convoy Minimum And Maximum Distances Between Units For Automatic Resupply Using Each Transportation Method.

Transportation Method	Barge	Rail	Truck	
Minimum Distance	10.0000	10.0000	10.0000	Kilometers
Maximum Distance	5000.0000	5000.0000	5000.0000	Kilometers

Convoy Size and Receiving Unit Size Minimum Values

Transportation Method	Barge	Rail	Truck	
Minimum Convoy Size	1	1	1	Units
Minimum Unit Size	SQUAD	SQUAD	SQUAD	

SLP SLP_1 Supply Category Related Data

Supply Category	SLP's SC Name	Equivalent Target Category		Target Subcategory		Reserved Fraction
(1)	COMBATANT-PE	(20)	SUPPLY.TYPE	(1)	COMBATANT-PERS_TGC	.50000
(2)	NON-CMBT-PER	(20)	SUPPLY.TYPE	(2)	NON-CMBT-PERS_TGC	.50000
(3)	CL.I	(20)	SUPPLY.TYPE	(3)	CL.I_TGC	.50000
(4)	CL.I.W	(20)	SUPPLY.TYPE	(4)	CL.I.W_TGC	.30000
(5)	CL.II	(20)	SUPPLY.TYPE	(5)	CL.II_TGC	.30000
(6)	CL.III.AIR	(20)	SUPPLY.TYPE	(6)	CL.III.AIR_TGC	.30000
(7)	CL.III.W	(20)	SUPPLY.TYPE	(7)	CL.III.W_TGC	.33000
(8)	CL.IV	(20)	SUPPLY.TYPE	(8)	CL.IV_TGC	.30000
(9)	CL.V	(20)	SUPPLY.TYPE	(9)	CL.V_TGC	.30000
(10)	CL.V.AIR	(20)	SUPPLY.TYPE	(10)	CL.V.AIR_TGC	.30000
(11)	CL.V.NAVY	(20)	SUPPLY.TYPE	(11)	CL.V.NAVY_TGC	.30000
(12)	CL.V.MINES	(20)	SUPPLY.TYPE	(12)	CL.V.MINES_TGC	.30000
(13)	CL.V.TORPEDO	(20)	SUPPLY.TYPE	(13)	CL.V.TORPEDOES_TGC	.30000
(14)	CL.V.AA-SR	(20)	SUPPLY.TYPE	(14)	CL.V.AA-SR_TGC	.30000
(15)	CL.V.AA-MR-1	(20)	SUPPLY.TYPE	(15)	CL.V.AA-MR-1_TGC	.30000
(16)	CL.V.AA-MR-2	(20)	SUPPLY.TYPE	(16)	CL.V.AA-MR-2_TGC	.30000
(17)	CL.V.AA-LR	(20)	SUPPLY.TYPE	(17)	CL.V.AA-LR_TGC	.30000
(18)	CL.V.AS-IR	(20)	SUPPLY.TYPE	(18)	CL.V.AS-IR_TGC	.30000
(19)	CL.V.AS-LG	(20)	SUPPLY.TYPE	(19)	CL.V.AS-LG_TGC	.30000
(20)	CL.V.AS-TV	(20)	SUPPLY.TYPE	(20)	CL.V.AS-TV_TGC	.30000
(21)	CL.V.AS-RDR	(20)	SUPPLY.TYPE	(21)	CL.V.AS-RDR_TGC	.30000
(22)	CL.V.AS-WIRE	(20)	SUPPLY.TYPE	(22)	CL.V.AS-WIRE_TGC	.30000

The Following Factions Access SLP SLP_1

US UK IT MU

APPENDIX D. MARINE LIGHT 2 DATA

Appendix D contains the first two pages and the last two pages of the data from Marine Light 2.

Time	Unit	Supply Index	Status	Action	Supplies
0	MSSG.24	4	1	4,100	3,000
0	MSSG.24	4	4	4,100	0
0	MSSG.24	7	1	4,100	5,000
0	MSSG.24	7	4	4,100	0
0	MSSG.24	9	1	4,100	375
0	MSSG.24	9	4	4,100	0
0	MSSG.13	4	1	4,100	3,000
0	MSSG.13	4	4	4,100	0
0	MSSG.13	7	1	4,100	5,000
0	MSSG.13	7	4	4,100	0
0	MSSG.13	9	1	4,100	375
0	MSSG.13	9	4	4,100	0
0	24MEU.SOC	4	1	4,100	8,000
0	24MEU.SOC	4	4	4,100	0
0	24MEU.SOC	7	1	4,100	4,000
0	24MEU.SOC	7	4	4,100	0
0	24MEU.SOC	9	1	4,100	668
0	24MEU.SOC	9	4	4,100	0
0	13MEU.SOC	4	1	4,100	8,000
0	13MEU.SOC	4	4	4,100	0
0	13MEU.SOC	7	1	4,100	4,000
0	13MEU.SOC	7	4	4,100	0
0	13MEU.SOC	9	1	4,100	668
0	13MEU.SOC	9	4	4,100	0
0.01	24MEU.SOC	4	1	4,103	8,000
0.01	24MEU.SOC	7	1	4,103	4,000
0.01	24MEU.SOC	9	1	4,103	668
0.02	13MEU.SOC	4	1	4,103	8,000
0.02	13MEU.SOC	7	1	4,103	4,000
0.02	13MEU.SOC	9	1	4,103	668
0.25	24MEU.SOC	4	1	4,403	6,097.76
0.25	24MEU.SOC	7	1	4,403	3,011.82
0.25	24MEU.SOC	7	1	4,403	3,011.82

0.25	24MEU.SOC	4	4	4,404	1,902.24
0.25	24MEU.SOC	7	4	4,404	988.18
0.25	13MEU.SOC	4	1	4,403	6,177.02
0.25	13MEU.SOC	7	1	4,403	3,053
0.25	13MEU.SOC	4	1	4,403	6,177.02
0.25	13MEU.SOC	7	1	4,403	3,053
0.25	13MEU.SOC	4	4	4,404	1,822.98
0.25	13MEU.SOC	7	4	4,404	947
0.27	MSSG.13	4	1	4,407	600
0.27	MSSG.13	7	1	4,407	1,320
0.27	MSSG.13	4	1	4,407	600
0.27	MSSG.13	7	1	4,407	1,320
0.27	MSSG.24	4	1	4,407	600
0.27	MSSG.24	7	1	4,407	1,320
0.27	MSSG.24	4	1	4,407	600
0.27	MSSG.24	7	1	4,407	1,320
0.29	MSSG.24	4	1	4,102	3,600
0.29	MSSG.13	4	1	4,102	3,600
0.33	MSSG.24	4	1	4,403	3,091.87
0.33	MSSG.24	7	1	4,403	1,291.72
0.33	MSSG.24	4	1	4,403	3,091.87
0.33	MSSG.24	7	1	4,403	1,291.72
0.33	MSSG.24	7	4	4,404	3,708.28
0.33	MSSG.13	4	1	4,403	3,091.87
0.33	MSSG.13	7	1	4,403	1,291.72
0.33	MSSG.13	4	1	4,403	3,091.87
0.33	MSSG.13	7	1	4,403	1,291.72
0.33	MSSG.13	7	4	4,404	3,708.28
0.47	13MEU.SOC	4	4	4,417	0
0.47	13MEU.SOC	7	4	4,417	0
0.47	13MEU.SOC	4	1	4,408	8,577.02
0.47	13MEU.SOC	7	1	4,408	6,733
0.47	13MEU.SOC	4	1	4,408	8,577.02
0.47	13MEU.SOC	7	1	4,408	6,733
0.47	13MEU.SOC	4	1	4,411	8,000
0.47	13MEU.SOC	7	1	4,411	4,000
0.47	13MEU.SOC	4	1	4,411	8,000
0.47	13MEU.SOC	7	1	4,411	4,000
0.47	24MEU.SOC	7	1	4,411	4,000
:	:	:	:	:	:
:	:	:	:	:	:
2.33	MSSG.24	4	1	4,403	3,218.52
2.33	MSSG.24	7	1	4,403	4,957.53

2.33	MSSG.13	4	1	4,403	2,837.7
2.33	MSSG.13	7	1	4,403	4,957.57
2.33	MSSG.13	4	1	4,403	2,837.7
2.33	MSSG.13	7	1	4,403	4,957.57
2.33	24MEU.SOC	4	1	4,201	4,457.63
2.33	24MEU.SOC	7	1	4,201	3,922.88
2.33	24MEU.SOC	9	1	4,201	634.39
2.33	24MEU.SOC	4	1	4,201	4,457.63
2.33	24MEU.SOC	7	1	4,201	3,922.88
2.33	24MEU.SOC	9	1	4,201	634.39
2.33	13MEU.SOC	4	1	4,201	7,970.84
2.33	13MEU.SOC	7	1	4,201	3,971.96
2.33	13MEU.SOC	4	1	4,201	7,970.84
2.33	13MEU.SOC	7	1	4,201	3,971.96
2.34	24MEU.SOC	4	4	4,417	843.64
2.34	24MEU.SOC	4	1	4,408	7,076.15
2.34	24MEU.SOC	7	4	4,417	0
2.34	24MEU.SOC	7	1	4,408	7,602.88
2.34	24MEU.SOC	7	1	4,411	4,000
2.34	24MEU.SOC	7	1	4,413	4,000
2.38	24MEU.SOC	4	1	4,201	7,049.84
2.38	24MEU.SOC	7	1	4,201	3,974.69
2.38	24MEU.SOC	9	1	4,201	634.11
2.38	24MEU.SOC	4	1	4,201	7,049.84
2.38	24MEU.SOC	7	1	4,201	3,974.69
2.38	24MEU.SOC	9	1	4,201	634.11
2.38	13MEU.SOC	4	1	4,201	7,941.67
2.38	13MEU.SOC	7	1	4,201	3,943.92
2.38	13MEU.SOC	4	1	4,201	7,941.67
2.38	13MEU.SOC	7	1	4,201	3,943.92
2.42	24MEU.SOC	4	1	4,201	7,023.72
2.42	24MEU.SOC	7	1	4,201	3,949.59
2.42	24MEU.SOC	9	1	4,201	633.92
2.42	24MEU.SOC	4	1	4,201	7,023.72
2.42	24MEU.SOC	7	1	4,201	3,949.59
2.42	24MEU.SOC	9	1	4,201	633.92
2.42	13MEU.SOC	4	1	4,201	7,912.52
2.42	13MEU.SOC	7	1	4,201	3,915.88
2.42	13MEU.SOC	4	1	4,201	7,912.52
2.42	13MEU.SOC	7	1	4,201	3,915.88
2.46	24MEU.SOC	9	1	4,201	633.67
2.46	24MEU.SOC	4	1	4,201	6,997.82
2.46	24MEU.SOC	7	1	4,201	3,924.68
2.46	24MEU.SOC	9	1	4,201	633.67

2.46	13MEU.SOC	4	1	4,201	7,883.37
2.46	13MEU.SOC	7	1	4,201	3,887.85
2.46	13MEU.SOC	4	1	4,201	7,883.37
2.46	13MEU.SOC	7	1	4,201	3,887.85
2.5	24MEU.SOC	4	1	4,403	5,326.31
2.5	24MEU.SOC	7	1	4,403	3,056.36
2.5	24MEU.SOC	4	1	4,403	5,326.31
2.5	24MEU.SOC	7	1	4,403	3,056.36
2.5	24MEU.SOC	7	1	4,414	4,000
2.5	24MEU.SOC	4	4	4,404	2,673.69
2.5	13MEU.SOC	4	1	4,403	5,994.94
2.5	13MEU.SOC	7	1	4,403	2,906.85
2.5	13MEU.SOC	4	1	4,403	5,994.94
2.5	13MEU.SOC	7	1	4,403	2,906.85
2.5	13MEU.SOC	4	1	4,414	8,000
2.5	13MEU.SOC	7	1	4,414	4,000
2.5	24MEU.SOC	4	1	4,201	5,300.61
2.5	24MEU.SOC	7	1	4,201	3,975.29
2.5	24MEU.SOC	9	1	4,201	633.32
2.5	24MEU.SOC	4	1	4,201	5,300.61
2.5	24MEU.SOC	7	1	4,201	3,975.29
2.5	24MEU.SOC	9	1	4,201	633.32
2.5	13MEU.SOC	4	1	4,201	7,970.85
2.5	13MEU.SOC	7	1	4,201	3,971.97
2.5	13MEU.SOC	4	1	4,201	7,970.85
2.5	13MEU.SOC	7	1	4,201	3,971.97

APPENDIX E. SUPPLY CATEGORIES

Appendix E contains the supply categories and their shipment and usage types that are used in JTLS. For this thesis Indices 4, 7 and 9 were used. These indices were used in column 3 of the data files.

Index	1	COMBATANTS	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	2	NON-CMBT-PER	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	3	CL.I	Shipment Type:	1 DRY	Usage Type:	1 PER PERSON
Index	4	CL.I.W	Shipment Type:	2 WET	Usage Type:	1 PER PERSON
Index	5	CL.II	Shipment Type:	1 DRY	Usage Type:	1 PER PERSON
Index	6	CL.III.AIR	Shipment Type:	2 WET	Usage Type:	3 AS USED
Index	7	CL.III.W	Shipment Type:	2 WET	Usage Type:	1 PER PERSON
Index	8	CL.IV	Shipment Type:	1 DRY	Usage Type:	1 PER PERSON
Index	9	CL.V	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	10	CL.V.AIR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	11	CL.V.NAVY	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	12	CL.V.MINES	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	13	CL.V.TORP	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	14	CL.V.AA-SR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	15	CL.V.AA-MR1	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	16	CL.V.AA-MR2	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	17	CL.V.AA-LR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	18	CL.V.AS-IR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	19	CL.V.AS-LG	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	20	CL.V.AS-TV	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	21	CL.V.AS-RDR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	22	CL.V.ASWIRE	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	23	CL.V.LGB-1	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	24	CL.V.LGB-2	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	25	CL.V.SA-SR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	26	CL.V.SA-MR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	27	CL.V.SA-LR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	28	CL.V.SS-SR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	29	CL.V.SS-MR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	30	CL.V.SS-LR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	31	CL.V.N	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	32	CL.V.W.ICM	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	33	CL.V.Z.CHEM	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	34	CL.VI	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	35	CL.VII	Shipment Type:	3 S.P	Usage Type:	1 PER PERSON
Index	36	CL.VII.AIR	Shipment Type:	1 DRY	Usage Type:	3 AS USED
Index	37	CL.VII.AMPHI	Shipment Type:	3 S.P	Usage Type:	3 AS USED
Index	38	CL.VII.CBT-V	Shipment Type:	3 S.P	Usage Type:	3 AS USED
Index	39	CL.VIII	Shipment Type:	1 DRY	Usage Type:	2 PER DAY
Index	40	CL.IX	Shipment Type:	1 DRY	Usage Type:	3 AS USED

APPENDIX F. SUPPLY STATUS CATEGORIES

Appendix F contains the supply status categories that are used in JTLS. For this thesis on.hand (1) and due.in (4) were used. These indices were used in column 4 of the data files.

```
DEFINE .ON.HAND    TO MEAN 1
DEFINE .REORDER    TO MEAN 2
DEFINE .STK.OBJ    TO MEAN 3
DEFINE .DUE.IN     TO MEAN 4
DEFINE .BASIC.LOAD TO MEAN 5
DEFINE .JUST.LOST  TO MEAN 6
DEFINE .GDS.KNOWS  TO MEAN 7
```

APPENDIX G. SUPPLY ACTION CODES

Appendix G contains the supply action codes that are used in JTLS. These codes were used in column 5 of the data files.

```
DEFINE .PP.SUPCAT.INITIAL.DATA              TO MEAN 4100
DEFINE .PP.SUPCAT.CONTROLLER.ACTION         TO MEAN 4101
DEFINE .PP.SUPCAT.LOGIN.ARRIVE              TO MEAN 4102
DEFINE .PP.SUPCAT.UNIT.ARRIVE               TO MEAN 4103
DEFINE .PP.SUPCAT.UNIT.RETURN.TO.ACTION     TO MEAN 4104
DEFINE .PP.SUPCAT.INITIAL.MAGIC.ISSUE       TO MEAN 4105

DEFINE .PP.SUPCAT.COMBAT.USAGE              TO MEAN 4201
DEFINE .PP.SUPCAT.FIRED.ARTILLERY           TO MEAN 4202
DEFINE .PP.SUPCAT.FIRED.MISSILE             TO MEAN 4203
DEFINE .PP.SUPCAT.ARTILLERY.DAMAGE          TO MEAN 4204
DEFINE .PP.SUPCAT.MISSILE.DAMAGE            TO MEAN 4205
DEFINE .PP.SUPCAT.AIR.ATK.DAMAGE            TO MEAN 4206
DEFINE .PP.SUPCAT.UNIT.ATTACHED             TO MEAN 4207
DEFINE .PP.SUPCAT.UNIT.DETACHED             TO MEAN 4208
DEFINE .PP.SUPCAT.MINEFIELD.LAYED           TO MEAN 4209
DEFINE .PP.SUPCAT.USED.MOVING               TO MEAN 4210
DEFINE .PP.SUPCAT.NBC.DAMAGE                TO MEAN 4211
DEFINE .PP.SUPCAT.COMBAT.DAMAGE             TO MEAN 4212

DEFINE .PP.SUPCAT.AIR.MISSION.LOAD          TO MEAN 4301
DEFINE .PP.SUPCAT.AIR.MISSION.RETURNED      TO MEAN 4302
DEFINE .PP.SUPCAT.AIR.MOVE.PICKUP           TO MEAN 4303
DEFINE .PP.SUPCAT.AIR.MOVE.DELIVERY         TO MEAN 4304

DEFINE .PP.SUPCAT.INITIAL.ISSUE             TO MEAN 4401
DEFINE .PP.SUPCAT.INITIAL.RECEIPT           TO MEAN 4402
DEFINE .PP.SUPCAT.CONSUMED                  TO MEAN 4403
DEFINE .PP.SUPCAT.REQUISITIONED             TO MEAN 4404
DEFINE .PP.SUPCAT.REQUIREMENT.ARRIVED       TO MEAN 4405
DEFINE .PP.SUPCAT.PLAYER.ORDER              TO MEAN 4406
DEFINE .PP.SUPCAT.SHIPPED                   TO MEAN 4407
DEFINE .PP.SUPCAT.SHIPMENT.ARRIVED          TO MEAN 4408
DEFINE .PP.SUPCAT.RETURNED.TO.SENDER        TO MEAN 4409
DEFINE .PP.SUPCAT.ADA.RESUPPLY              TO MEAN 4410
DEFINE .PP.SUPCAT.OVERLOAD.PASSED           TO MEAN 4411
DEFINE .PP.SUPCAT.OVERLOAD.TAKEN            TO MEAN 4412
DEFINE .PP.SUPCAT.DUMPED.TO.TARGET          TO MEAN 4413
DEFINE .PP.SUPCAT.TAKEN.FROM.TARGET         TO MEAN 4414
DEFINE .PP.SUPCAT.MANDATORY.SHIPMENT        TO MEAN 4415
DEFINE .PP.SUPCAT.MANDATORY.RECEIPT         TO MEAN 4416
DEFINE .PP.SUPCAT.REQUIREMENT.CANCELLED     TO MEAN 4417
DEFINE .PP.SUPCAT.BACKHAULED                TO MEAN 4418
DEFINE .PP.SUPCAT.BACK.ON.CONVOY            TO MEAN 4420
```

APPENDIX H. STEPS FOR CREATING *EXCEL GRAPHS*

The following steps were used to create the graphs from the *Excel* spreadsheets:

1. Highlight the first column.
2. Hold down the *ctrl* button while highlighting the last two columns.
3. Click on *insert* on the tool bar and select *chart*.
4. Select *on this page*.
5. Place icon where you want the graph to appear.
6. Open the box to the size you want the graph to be.
7. Step 1 of 5 will appear. Click on *next*.
8. Select *XY Scatter*. Click on *next*.
9. Select *Type 2*. Click on *next*.
10. Step 4 will appear. Click on *next*.
11. Type in the chart title and axis titles. Click on *finish*.
12. To change line attributes and to get the legend to read correctly, go to the chart and click on the appropriate line in the chart.
13. In Patterns you can change the color.
14. In Names and Values you can change the label in the legend.

LIST OF REFERENCES

1. Joint Chiefs of Staff, CJCSM 3500.04, *Universal Joint Tasks List*, version 2.1, The Pentagon, Washington, D.C., May 1995.

2. Gordon, Kerry, *A Methodology for Evaluating Operational Firepower During a Computer-Aided Exercise*, Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1996.

3. Brown, Kevin, *Evaluating Operational Maneuver in a Computer-Aided Exercise*, Master's Thesis, Naval Postgraduate School, Monterey, CA, Aug 1996.

4. Thurman, John, *A Methodology for Evaluating Force Protection During a Computer-Aided Exercise,* Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1996.

5. Mustin, John, *Evaluating Carrier Battlegroup Anti-Air Warfare Capability in a Computer-Aided Exercise,* Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1996.

6. Sullivan, Mark, *A Methodology for Evaluating a Joint Mobilization Plan Using the Joint Theater Level Simulation (JTLS)*, Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1996.

7. Towery, Chris, *A Methodology for Evaluating Intelligence Functions During a Computer-Aided Exercise,* Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1995.

8. Combs II, Ray, *A Methodology for Evaluating Execution of Universal Joint Tasks Within the Context of a Computer-Aided Exercise,* Master's Thesis, Naval Postgraduate School, Monterey, CA, Sep 1995.

9. Amphibious Warfare School, A(0)3000, *MAGTF Expeditionary Operations (Eastern Crescent)*, Quantico, VA, Nov 1995.

10. Joint Chiefs of Staff, *JMETL Development Handbook,* The Pentagon, Washington, D.C.,

11. Joint Pub 1, *Joint Warfare of the US Armed Forces*, Nov 1991.

12. Joint Warfighting Center, *Models and Simulations Overview*, Fort Monroe, VA, Oct 1995.

13. Joint Pub 4-0, *Doctrine for Logistics Support of Joint Operations*, Sep 1992.

14. Headquarters, United States Marine Corps, *Marine Corps Capabilities Plan, Vol 1*, Washington, D.C., Jun 1992.

15. Krulak, General Charles C., USMC, "A War of Logistics", *US Naval Institute Proceedings,* US Naval Institute, Annapolis, MD, Nov 1991.

16. Brabham, Brigadier General James A., USMC, "Training, Education Were the Keys", *US Naval Institute Proceedings,* US Naval Institute, Annapolis, MD, Nov 1991.

17. Wilson, Captain Stephen M., USMC, Telephone conversation with member of MSSG 24, 5 Jun 1996.

18. Headquarters, Department of the Army, FMFM 4, *Combat Service Support*, Aug 1991.

19. Joint Warfighting Center, D-J-00013-J, *Joint Theater Level Simulation Analyst Guide*, Fort Monroe, VA, Sep 1994.

20. Peterson, Dale, Interview by author with the Senior Military Analyst, Computer Sciences Corporation, Quantico, VA, 28 Mar 1996.

INITIAL DISTRIBUTION LIST

No. of Copies

1. Defense Technical Information Center. 2
   8725 John J. Kingman Rd, Ste 0944
   Ft Belvoir, VA 22060-6218

2. Dudley Knox Library. 2
   Naval Postgraduate School
   411 Dyer Rd
   Monterey, CA 93943-5101

3. Dr. Sam Parry, Code OR/Py. 10
   Naval Postgraduate School
   Monterey, CA 93943-5002

4. Dr. Lyn Whitaker, Code OP/Wh. 1
   Naval Postgraduate School
   Monterey, CA 93943-5002

5. Maj Mark J. Cwick. 3
   14 Lawhorn Rd
   Stafford, VA 22554

6. Director, Training and Education. 1
   MCCDC, Code C46
   1019 Elliot Rd
   Quantico, VA 22134-5027

7. Director, Marine Corps Research Center 2
   MCCDC, Code C40RC
   2040 Broadway St
   Quantico, VA 22134-5107

8. Director, Studies and Analysis Division 1
MCCDC, Code C45
3300 Russell Rd
Quantico, VA 22134-5130

9. Joint Warfighting Center. 3
Attn: Maj Greg Brouillette
Bldg 96, Fenwick Rd
Fort Monroe, VA 23651

10. Defense Manpower Data Center. 2
400 Giggling Rd
Seaside, CA 93955-6771

11. Rolands and Associates Inc. 1
500 Sloat Ave
Monterey, CA 93940